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MATTEISM ON ITS DEFENCE.

QUACKERY appears to be one of the most difficult phenomena in the world to deal with. You may "scotch your snake," but it takes a lot of killing. For 30 years Count Mattei's "remedies" have been known, and during that time their fraudulent pretensions have been exposed repeatedly by competent scientists; yet in this month's *Humanitarian*, the irrepressible Mr. Gliddon, who appears to hold a brief *in perpetuam* from the exploiters of Matteism, comes forward with as lively a defence as ever. Strive we never so hopefully to believe in the increasing sanity of the race, the most resolute optimism must break down and give place to a reluctant pessimism when the quacks flaunt their ill-gotten gains before us, and trot out the names of the distinguished personages which adorn their lists of dupes. The story is as old as the hills. The untutored savage trusts to his amulet, and the civilised man to his belt; or he swallows down with the most childlike faith the potions which he has seen so much advertised in the columns of a degenerated daily press. Even failure to obtain benefit fails to convince him of the futility of these secret remedies; he abandons one only to try another. And thus it will be to the end of the chapter, till all men are perfectly sane, that is to say, till all men possess unqualified wisdom—a very remote contingency.

Meanwhile, the quacks fatten upon the spoils of their victims, and grow rich.

Mr. Gliddon may be congratulated upon the proficiency which he has attained in the manipulation of specious arguments. He begins by endeavouring to enlist the sympathies of his reader on behalf of Matteism in the person of one, Mr. R. M. Theobald, who was deprived of his place on the Medical Register "on account of the attitude he has assumed towards Count Mattei's remedies." [This, by the way, is a very euphemistic rendering of the actual indictment, which charged the gentleman named with "infamous conduct in a professional respect."] Having placed his reader in the proper sympathetic frame of mind, he proceeds to impress him by the statement that: "Sovereigns like the Emperor and Empress of Austria; heirs-apparent like Prince Ludwig of Bavaria; dukes and duchesses, such as the Duke of Mecklenburgh-Schwerin and the Duchess of Argyll; famous soldiers like Lord Roberts of India; celebrated writers, such as Robert Louis Stevenson, Lady Paget, Mrs. Talbot Coke, and Mr. W. T. Stead; medical men, such as Drs. Acworth and Vernon, artists like Mr. Louis Wain, who, by the way, has successfully treated cats by these remedies, as well as an enormous number of people in all conditions of life, have tested them, and proved their real value." We have very grave doubts whether all these distinguished personages would to-day write a single line in favour of the Mattei remedies. Some of them may have once *believed* in their

efficacy, as, for instance, Lady Paget and Mr. Stead; but we suspect that they would not now approve of their names being used in this way. And even if they did, how much does it prove in favour of the "remedies?" The value of the opinion of a duke, a duchess, an heir-apparent (or even of an artist who has physicked his neighbours' cats) on a medical or scientific matter, especially if it be a matter open to dispute, is practically worthless.

Much more to the point, and worthy to be considered, was the verdict of the Mattei Investigation Committee (*vide British Medical Journal*, August 13th, 1892, p. 369). This committee consisted of Sir Morell Mackenzie, Dr. Lawson Tait, and Dr. G. W. Potter, joined subsequently by Dr. John Hopkins. They constituted a committee of observation, not supervision or direction, and in this capacity watched the treatment of several *bonâ fide* cancer patients by the "electricities" of the Matteists, who administered them themselves. After three attempts to escape the observation—which, if they were to retain the good opinions of Lady Paget and Mr. Stead, and others, who were anxious to see a genuine trial, they were bound to court—they finally backed out. The patients had been under treatment and observation for one year without sustaining any benefit whatever; and the chairman of the committee reported as follows: "Matteism, in the deliberate judgment of the committee, consists exclusively of vulgar, unadulterated, unredeemed quackery."

It may seem, however, a little unchivalrous to remind Mr. Gliddon, almost at the outset, of a certain episode in the history of Matteism which is, doubtless, extremely unpleasant for him to contemplate; we will see, therefore, what he has to say for himself. Quoth Mr. Gliddon: "The whole secret of the power of the Mattei remedies has not yet been disclosed. But we may give some of the reasons why they are so efficacious. *They are derived from the right sources.* They are all vegetable medicines. They owe their power to the fact that Count Mattei has learnt to draw out from the organic reservoirs in which solar energy is ever being stored up, some of the most potent healing forces which have streamed earthwards from the sun. When we eat vegetable foods, we take into our bodies transformed sunlight. Clerk Maxwell has pointed out the intimate relation and practical identity of light and electricity. And in view of his teaching, we may venture to say that when we consume vegetable matter, we incorporate into our systems electricity, which was first solar electricity, and then vegetable electricity."

Before perpetrating this convincing piece of logic, we think it possible that Mr. Gliddon may have sought inspiration in those inimitable verses commencing—

> An Eton stripling training for the laws,

for his arguments reek of the *afflatus* of the "horse-chestnut." But why poor Clerk Maxwell's name should be introduced as a shibboleth to conjure with, heaven only knows! The impressive italics "they are derived from the right sources" are used doubtless to convey an air of mystery — this being as much employed to-day by the common quack as ever it was by the old alchemists and magic-mongers of centuries ago. However, a little more light is thrown upon the origin of Mattei's electricities further on in the article, where it is stated that they "are derived from shrubs growing on the Appenines, the names of which are still kept a profound secret." But even in this we are disposed to perceive a borrowed idea. Mr. Gliddon has surely been studying the advertisements of a certain curative syrup of American origin, made from secret plants growing in a locality somewhere in the Red Indian country.

But we must take Mr. Gliddon more seriously, and if we are to do so must quote him without comment:—

> Count Mattei declares that his remedies contain vegetable electricity. The exact signification now attached by him to the phrase is doubtful. It is certain, however, that he was first led to use it by noticing the lightning-like rapidity with which his fluids acted upon the nerves, and the similarity between the effects produced by them, and the effects of a current from a galvanic battery.
>
> The crude saps of all plants are very much alike. The characteristic differences of plants do not reveal themselves in these fluids until they have been elaborated by the rays of the sun—may we not say by the solar electricity—and it is from these elaborated fluids that the most important medicinal substances are derivable. From these we obtain alkaloids, gum resins, glucosides, and many other highly important compounds.
>
> It may be noted that every living organism contains electricity. There is no shrub on earth that lives and grows without this. And is it not true that just as, in passing from one condition to another, certain compounds take up an amount of heat and render it latent, so in passing from one form into another, organic substances take up and render latent a certain amount of electricity, and that just as when heat has been rendered latent it may afterwards become radiant, so when electricity has been stored up in what we may call vegetable accumulators, it may, by certain means, as, for instance, by friction, be again given out and rendered current.
>
> I have said all this *not* because I am convinced that what Count Mattei calls vegetable electricity is electricity at all, but simply for the sake of showing that there is nothing absurd in the idea, and that his contention may after all be based on scientific facts. I even venture to defend the matter which has formed the subject of the largest amount of ridicule, the use of the words "red, yellow, and green electricity." When we speak of red, yellow and green, we simply indicate variations in wave lengths. And as there are variations in wave lengths in sound and heat, is it not true that there are variations in the wave lengths of electricity? Indeed, just as we have learnt to apply the word "ray," which was originally associated only with light, both to sound and heat, may we not apply the words red and yellow, which have hitherto been associated with light alone, also to electricity? If there be any truth in the modern view that what we call light is simply one of the modes in which electro-magnetic waves become perceptible to us, we are using the most strictly scientific phraseology when we speak of red electricity.

Our readers will agree that comment upon such arguments as these would be a work of supererogation. Mr. Gliddon's most severe satirist is himself, and, like the notorious Mrs. Malaprop, he may be trusted never to open his mouth without putting his foot into it.

Many object to the Mattei remedies on the ground that they are secret, others because they have found them to consist of nothing but water, or of water mixed with gummy matter—possibly Stickphast's. But Count Mattei, noble-hearted man, declares that if he were to reveal his secret, not three months would elapse before men in all parts of the world would be selling medicines which they would assert to be identical with his, and that, owing to the peculiar nature of the preparations, the public would have no means of ascertaining whether they were obtaining the genuine articles or specifics which resembled them only in name. Count Mattei is rich: he wants to be richer. So do all those who drive a profitable business in selling his nostrums. They know full well that secrecy is their sheet anchor. They have manipulated the secret for 30 years, but they are anxious to keep it as long as there is money to be made by trading upon it. Yet the Matteists profess to be actuated by the highest philanthropy! They are well aware that to hold the philanthropic card in their hand, is to play a winning game. And Mr. Gliddon has the effrontery to claim that

the Count (who, by the way, got Pope Pius IX. to give him his "Countship," doubtless for business purposes) is not depriving the world of the benefits of his discovery, and that he offers his remedies to all, as though he were a heaven-sent philanthropist. [Always provided, of course, that the necessary shekels are forthcoming.]

The remainder of Mr. Gliddon's article consists of an exercise in argument of the same ingenious but specious character as those which we have dealt with. As they scrupulously avoid the pitfalls which the play upon the word *electricity* leads to, and deal, moreover, with matters which are suitable for discussion in a strictly medical journal, we must deny our readers the amusement which we ourselves have extracted from them. As regards the suggested prosecution of Matteists to be undertaken by Her Majesty's Government, which Mr. Gliddon so complacently looks forward to, he knows very well that the Public Prosecutor is the most difficult functionary in the world to move, and so feels content to await an inquiry which he believes to be the very last thing that is likely to happen. If Mr. Gliddon is so anxious to show that "the Mattei theory and practice of medicine are quite in harmony with the most advanced teachings of modern science," which is his own claim for it, he knows very well that he can obtain his opportunity if he chooses. But he knows also very well, that whilst professing to be anxious to court inquiry, the Matteists have always wriggled away and done their best to throw dust in the eyes of the honest and impartial scientists who have been ready to conduct such inquiry. So long as the thing pays, the creatures who gain by it are ready to brook any amount of contumely.

MUIRHEAD *v.* THE COMMERCIAL CABLE COMPANY.

Our contemporary, *Engineering*, in a recent issue, discusses the question of the late Appeal judgment in the above case. The conclusion arrived at is not in accordance with our own, and, seeing the extreme difficulty of the whole matter, we are not at all surprised that differences of opinion should exist. The writer states, "The question of what was or was not in an inventor's mind at the time of taking out a patent has no bearing on the case; the question is rather whether or no he has helped the public by showing them how to bring about a certain desirable result." Now, what is the "desirable result" brought about by the use of a low resistance rheostat fixed at the apex of the bridge, and arranged so that the sum of the resistances in the two arms remains constant? There are two points involved here—first, the use of *low* resistances; and, second, the fixity of the sum of the two resistances. The writer of the article says: "Personally, with long lengths of cable, we attach no importance to the value of the sum of the resistances being maintained constant, and we should place more reliance in the evidence of men constantly engaged in practical work of this sort, than in scientific experts of whatever eminence." We gather from this statement that the writer is not himself acquainted with practical duplex working on long submarine cables, for if he were he would be able to state with more definiteness the fact that there is no practical advantage *whatever* in this "desirable result"; it certainly does not enable a desirable result to be obtained, which before was unattainable. We only have, therefore, to deal with the question of the value of the variation in the ratio of the arms of low resistance, which the low resistance rheostat effects. We are told, "For our part we can readily appreciate the vast importance of the 1880 patent, as being the first published means of adjustment by a low resistance in such a manner as to avoid reducing the signalling speed by extra retardation being involved at the same time." Now, has the writer of these words anything more than mere assumption to justify what he says? We, ourselves, will not theorise on the matter, lest we get into the position of the learned members of the Royal Society in the time of King James, who debated long and anxiously why it was that a pail of water with a live goose in it weighed *less* than the same pail of water without the goose, a difficult question which was only at last satisfactorily settled by the brilliant suggestion of an obscure member that it would, perhaps, be as well to try the experiment before continuing the debate—a suggestion which, history tells us, was carried out. We have it on excellent authority that the supposition that accurate balancing can be obtained by the rheostat in question is an absolute delusion, and that, as a matter of fact, the arm of the rheostat may be turned to any position without upsetting the balance and disturbing the signals; its existence does no harm, but for any practical good that it does, it might as well not exist; it is not a question of theory or of laboratory experiment, but one of practical fact in connection with cable working, and, with reference to this, it is surely unfair to the cause of justice for men of great reputation to give opinions (that is to state that certain things *are* so), upon questions of the day, of which they have had no opportunity of judging for themselves, and which therefore simply devolves into endorsing the biassed opinions of those who instruct them. It does not appear to have struck Mr. Justice Kennedy that improved results may be brought about by a better adaptation of old principles without the introduction of anything that by any stretch of imagination can be called new. Doubtless the matter will not be allowed to rest as it is, and an appeal to the Lords may result in another reversal; but whichever way the final verdict may be given, it will hardly be an entirely satisfactory one, seeing that it must be almost akin to a game of chance.

A New Rival to Coal Gas.

The interests of the coal gas monopolists are threatened with a new danger, the possibility of which they have never dreamed of. Electricity they have regarded as a very poor substitute for gas as an illuminant, though they probably have some difficulty in preserving this attitude; but they little thought that electricity would ever be an active agent in producing an illuminating gas rivalling their own sorry product in brilliancy, absence from smoke, and cheapness. This, it is claimed by Dr. Wyatt in the *Engineering and Mining Journal*, has been effected by Mr. Thos. L. Willson, at Spray, N.C., U.S.A. Without entering into the details of the process, its main features may be broadly stated as follows:—Lime is mixed with an excess of finely divided coal, and the mixture decomposed, deoxidised, or reduced within an electric arc. The mixed material being between separated electrodes, and the arc being quite close to that portion immediately under treatment, the formation of a bath of the fused resulting compound, viz., calcium carbide, and the consequent ebullition and fluctuation in the resistance of the arc are prevented. The calcium carbide cools to a black brittle mass which possesses remarkable properties, amongst which is that it decomposes water, forming acetylene, which is a gaseous hydrocarbon. This burns with a smoky flame, but when it is mixed either with water, gas or with atmospheric air, the flame is white. Dr. Wyatt is very enthusiastic over this new illuminant, but so far he has little more than laboratory experiments to go by. Prof. Henry Morton has also some belief in its future usefulness as may be seen by referring to our "Notes" columns, but its true value can only be judged when it has been thoroughly tried on a large scale commercially. Until this has happened the dovecotes of the monopolists may cease from fluttering.

ELECTRO-CHEMICAL PROGRESS DURING THE YEAR 1894.

By J. SWINBURNE.

It is difficult to say exactly what has been done during the last twelve months, as the various workers are inclined to keep their work, and the results of their experience, to themselves, and to object to having their results published. In addition to this, one knows of various processes and developments in a professional way, which does not authorise one to publish any accounts of them.

Probably the greatest development during the last year has been in copper refining, but practically no details have been made public, so little can be said. The Elmore Companies have turned out some very large deposited tubes, and their products appear to sell well, but of course their turnover is likely to be smaller than that of the various electrolytic refiners, especially those in the States.

Chlorate of potash is now being made electrolytically from muriate of potash. This is a simple process. The anodes are platinum, which is not attacked appreciably in an alkaline solution. There are various patents for details of vats, and so on, but no master patents, so that there is a fair field for commercial work. There are chlorate of potash works at Vallorbes, in Switzerland, at Ottawa, and a large works is either being put up, or now in operation, in Sweden. The price of chlorate is now under 5½d. a pound, and this is, doubtless, to some extent, due to the electrical works.

Caustic soda and bleaching powder have always tempted the electro-chemist, because the total turnover is so enormous; but, on the other hand, there is less chance of a large profit on products that are sold by the ton. The anode difficulty stands where it did, the only promising solution being the use of a cheap form of carbon, such as rough retort carbon, which can be cheaply replaced as it wears away.

The number of improved forms of vat, and of curious developments of porous cell, increases daily, and each inventor generally thinks that the industry was waiting for his particular little plan, and that he has solved the problem, whereas the difference in expense of working one kind of vat and another is generally a very small matter. The Electro-Chemical Company, which was formed last January, had some difficulty in finding suitable premises. These have now been purchased, and plant for 1,100 horse-power is being put down. The boilers and some of the vats are in, and the whole will most likely be at work in a few months. The Allgemeine Elektricitäts Gesellschaft is putting down 2,000 horse-power for soda manufacture. It will, however, take many thousands of horse-power to make any appreciable portion of the chemicals now used.

Ozone has attracted very many inventors. Messrs. Siemens & Halske, of Berlin, have been working at this development for some time, and have obtained interesting and important results, but I do not know how far I am at liberty to describe what was shown me as a matter of courtesy. Mr. Andreoli has been doing good work, and bleaching as well as sterilising and disinfecting by ozone may become an important industry in the future, but is hardly so yet.

Experimental work has been carried on actively in various directions, notably the reduction of nitro-compounds, such as nitro-benzol. Vautin's process for separating silver from gold by using the gold as anode and fused chloride of silver as electrolyte, deserves mention as a very simple way of conducting an otherwise troublesome process.

A large and influential company, with R. W. Wallace as one of the directors, and with Lord Kelvin as scientific adviser, has been formed for manufacturing aluminium electrically in this country. This company also owns a simple method of soldering the metal.

An experimental plant is at work in a brewery hurrying vinegar manufacture considerably; but, again, I am not at liberty to describe it. Mr. Ferranti is also reported to be hurrying the manufacture of white lead electrically.

Messrs. Cowper-Coles and others are at work on real galvanising; that is to say, coating with zinc by electrolysis. Though electro-zincing was abandoned in the old days in favour of dipping, with modern machinery and modern knowledge available, zincing can be done better electrically.

The stripping of scrap tin is no longer a problem to be solved; the problem is to find the scrap tin that has to be stripped.

The electrolysis of other people's water pipes is now quite a large industry in the United States, but, as usual, we are behind in this country, and very little has been done in that line, though it is hoped that 1895 will be a good year for electrical traction.

Electro-chemistry as an industry is in a unique position. It wants development, but in most new industries there are prizes in the way of valuable patents to be won; but the electrolytic manufacture of nearly every commercial chemical to which electrolysis could be applied has been described, and often, to some extent, worked out by enthusiastic people who are dead; and there are hardly any master patents to be got. The only things to protect are small details of construction or working. It might seem as if this were a great advantage; and so it ought to be, but, unfortunately, the industry requires capital, and capital generally means limited companies, and a limited company needs promotion and apparent acquisitions of property, such as patents. Companies who pay little, or give deferred shares for patents, and who go to work with energy and good management, should do splendidly by manufacturing whatever chemical pays best, without being tied down to anybody's patents or processes, and by keeping abreast of the times and continually making detail improvements in their processes, and keeping their own counsel. It is generally very difficult to get capital for such companies, and the wild inventor with patents seems to be a necessity.

ON THE ELECTRICAL RESISTANCES OF CERTAIN POOR CONDUCTORS.*

By B. O. PEIRCE.

Since the subject of electricity began to be studied seriously, many experimenters have made lists of substances arranged in the order of their electrical conductivities. These lists have not agreed with one another in all respects; but at one end of every one of them metals have stood, and at the other end such insulating substances as ebonite, glass, paraffin, shellac, and mica. Somewhere between these extremes have appeared the so-called "half-conductors,"† like wood and some kinds of stone. How these latter are to be classed depends very much, of course, upon the uses to which they are put. For work with the small charges and high potentials of experiments in electrostatics, we must generally consider wood as a conductor; while, for practical purposes, we may regard the wooden base upon which a telegraph instrument is mounted as a perfect insulator.

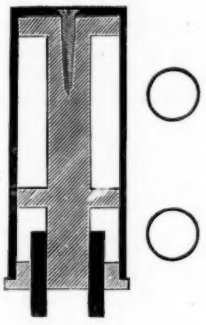
In making electrical measurements in the laboratory, it is often necessary to be able to change quickly the connections of one's apparatus, and for this purpose some kind of "switchboard" must generally be provided. Sometimes a dry wooden board, into which holes have been bored to form mercury cups, will suffice; sometimes a plate of ebonite or a non-combustible slab of slate or marble is required.

I have been obliged, during the last three years, to procure several hundred more or less complicated switchboards, and many of these had to be used in making accurate measurements of electrical quantities. It has been necessary, therefore, to determine under what circumstances hard dry wood or red vulcanised fibre may safely be used, and when marble or ebonite, or even a block of freshly scraped paraffin, is required. For use with these switchboards I have provided several hundred resistance coils of German silver, platinoid, and manganin wire, wound on spools two inches in diameter over all, and from four to eight inches long. The coils are furnished with stout copper terminals (fig. 1), and are protected by cylindrical shields made of brass or pasteboard tube.

* *Proceedings* of the American Academy. Presented October 10th, 1894.

† Du Moncel, *Annales de Chemie et de Physique*, [5], x., 1877; Addenbrooke, Muir & Jamieson's Pocket-Book, p. 194.

The copper terminals are screwed, with axes parallel to each other, and one inch apart, into one end of each spool. Spools and shields together act as shunts to the coils, and it has been necessary to determine a lower limit for the resistance which such a shunt could offer in practice. It has been necessary also to measure the insulation resistance between the two mercury cups, on a switchboard, into which the terminals



FIGS. 1 AND 2.

of one of the resistance coils dip. These cups are formed by holes three-eighths of an inch in diameter (fig. 2), and five-eighths or three-quarters of an inch deep. The axes of each pair of holes are one inch apart. The holes are bored, or drilled, in a lathe, in the top of the switchboard, with a Förstner bit if the material be wood or vulcanised fibre or ebonite, with a flat or twist drill moistened with water if slate or marble be used.

In order to get such information as I needed with respect to the insulation resistance which might safely be counted on in the case of wood, marble, or vulcanised fibre, used for the purposes just described, I made a long series of measurements, with the help of a battery of twelve dry cells, and an absolutely calibrated high-resistance mirror galvanometer, on a large number of specimens. Of course individual measurements of this sort have little general value, but a large number of experiments on different samples of material of a given kind make it possible to set a lower limit to the resistance of this substance when used in a given way, and such knowledge as this is often useful when one is planning apparatus. For instance, my experience seems to show that it is perfectly safe to assume that the specific resistance per cubic centimetre of an inch-thick slab of pure white Vermont marble, which has been standing exposed to the air in a fairly dry room for three weeks, is not less than 10^9 ohms, and is probably as much as 10^{10} ohms. Really dry white marble has a far higher specific resistance than this. It is safe also to set a lower limit for the specific resistance of seasoned wood of a given kind, but only in the sense that wood of resistance as high as this can always be obtained without difficulty in the market. Abnormal specimens occur. In measuring the insulation resistances between the copper terminals of unparaffined maple and birch spools, like or similar to the one represented in fig. 1, I experimented upon a large number of spools which had been lying for about a year in a certain dry closet. The smallest resistance in any case was 1,100 megohms, and the average resistance was more than 2,000 megohms. This is what one may expect to get in spools of this kind. In the same closet were some spools of a different lot, bought of the maker of the other spools, and in no way different in appearance from them. These also had been seasoning beside the others for a year, yet the average insulation resistance of these spools was only a little over one megohm. This is an extreme case. The nearest approach to it that I found in experimenting on other lots of spools was that of some which had been standing for a long time in the damp basement of the laboratory, and represent what the ordinarily good dry spool might become if it were placed for months in a moist place. Yet the lowest resistance in the case of these spools was more than 100 megohms.

It is, of course, well known that the insulation resistance of a porous half-conductor depends very much upon the amount of moisture which it contains, and that this moisture may give rise to all manner of anomalies, as Du Moncel has shown. Thus, white marble when it comes from the mill is often a fairly good conductor, owing to the water which it has absorbed in the process of manufacture, but a fortnight's drying in the sun sometimes increases its resistance ten thousand fold. It is now almost always possible to get kiln-dried wood, and after wood or marble has once been thoroughly dried, an immersion in a bath of hot paraffin tends to prevent the reabsorption of moisture. Red vulcanised fibre absorbs hot paraffin greedily; but I do not think that it would be easy to saturate a piece of fibre so thoroughly with paraffin that a drop of water allowed to rest on its surface for a few moments would not begin to raise a blister.

Prolonged immersion in clean, hot, melted paraffin always increases the insulation of a half-conductor, even if the bath leaves no perceptible coating on the outside. This increase, however, is very slight in the cases of some closed grained substances like rosewood, though it may amount to three or four times the original resistance in the case of a porous conductor. If while such a conductor is immersed in hot paraffin the bath and its contents be placed under the receiver of an air pump, and the air be alternately exhausted from and readmitted to the receiver, the resistance of the conductor is always materially increased. This process is in common use for the purpose of improving the insulation between the layers of covered wire in galvanometer coils. A coat of shellac, when not thoroughly dry, often lowers very much the insulation resistance of a porous half-conductor.

The following table shows the results of measurements of the resistance between the two members of each of a large number of pairs of mercury cups of the size shown in fig. 2 bored in the tops of slabs of different substances. The specific resistance of wood for currents going across the grain is generally from 20 to 50 per cent. higher than for currents going with the grain. The figures given below may be taken

TABLE I.

Substance.	No. of pairs of cups.	Lowest resistance in megohms.	Average resistance in megohms.
Ash	13	550	920
Cherry	15	1,100	4,000
Mahogany	14	430	730
Oak	17	220	420
Pine	24	330	630
Hard pine	8	10	48
Black walnut ...	30	1,100	3,000
Red fibre	6	2	4

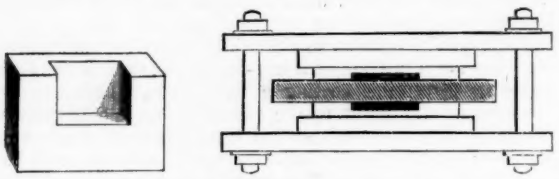
as referring to currents going with the grain. I procured, wherever I could conveniently, a number of pieces of seasoned wood of each variety named, rejecting none, and I believe that the numbers in the table represent fairly what one may expect in practice. The number in the second column of the table, in the same horizontal line with the name of a substance, shows how many pairs of mercury cups bored in slabs of this substance were experimented on, while the numbers in the next two columns give in megohms the lowest and the average resistance between the members of these pairs. Sometimes a single pair of cups only was bored in a slab, sometimes two or three. The resistances between the members of pairs of mercury cups bored in the single specimens of cypress and maple that I had were, in the average, upwards of 2,000 megohms.

TABLE II.

Substance.	Lowest specific resistance in megohms found among the specimens tested.	Average specific resistance in megohms of the specimens tested.
Ash	380	700
Cherry	2,800	6,000
Mahogany	310	610
Oak	1,050	2,200
Hard pine	17	1,050
White pine ...	360	1,470
Black walnut ...	320	2,100
Vulcanised fibre ...	3	60
Slate	184	280
Soapstone	330	500
White marble ...	2,000	8,800

Choice pieces of wood of each of the seven kinds named in the table would yield insulation resistances far higher than those given in the column of averages, and not less than 1,000 megohms even in the case of hard pine.

Table II. gives the results of a great number of experiments upon the electric resistances of slabs of different substances, through which currents were sent by means of mercury electrodes placed opposite each other. Each electrode was contained in a cavity excavated in a piece of ebonite (fig. 3), and was generally about 60 square centi-



Figs. 3 and 4.

metres in area. Comparative measurements made with slabs of wood cut across the grain were rather unsatisfactory, for the reason that there seemed to be in every case a resistance of contact (*Uebergangswiderstand*) at the common surface of the mercury and wood, and the magnitude of this resistance depended very much upon the roughness or smoothness of the cut, and was sometimes greater than the intrinsic resistance of the wood. In experiments made with currents sent across the grain of the wood through slabs of different thicknesses cut from the same plank, the resistances seemed to follow Ohm's law so nearly that the contact resistances were of comparatively small importance. The contact resistance between two pieces of wood pressed together seemed to be great, since the insulation resistance of a compound slab formed of two in close contact was far greater than the sum of the resistances of the two taken singly. To avoid any disturbing effects that might arise from injury to the substance at tool-cut edges, slabs were sometimes used (see the shaded portion of fig. 4) much greater in area than the electrodes, and this necessitated the making of allowances (based on experiments with zinc electrodes in a tank of solution of zinc sulphate) for the effect of the spreading of the lines of flow in the slab. This process was not entirely satisfactory, but the results are doubtless quite accurate enough for the purpose in view. The mercury electrodes were effectively insulated from the brass clamping bolts by the intervening slabs of ebonite.

All the slabs of stone were specially dried in the summer sun for about three weeks before they were experimented on. Through the kindness of Messrs. Bowker, Torrey and Co., of Boston, I was enabled to test the specific resistances of a large number of pieces of coloured marble of different kinds. A vein in a piece of marble used as a switchboard has been known to short-circuit a fire-alarm system, and it was to be expected that the specific resistances of most coloured marbles would prove to be less than that of white marble. In one instance, the specific resistance was as low as three megohms. The single piece of sandstone which I had at my disposal had been in a dry place in the laboratory for more than five years; its specific resistance was 30 megohms. The average specific resistance of hard pine as given in Table II. means little. I have seen a piece of this wood with a specific resistance as high as 4,000 megohms; but very resinous pieces of hard pine, however long they may have been dried, seem to have low specific resistances. Some thin birch, of the kind now used to separate from each other the successive plates of one or two forms of storage cell, had a specific resistance, when dry, of about 500 megohms.

Jefferson Physical Laboratory, U.S.A.,
August, 1894.

EXPERIMENTS IN CABLE SIGNALLING.

Mr. Delany's experiments in cable signalling, given in the *Electrical Engineer* of New York for December 19th, are very interesting as an instance of actual published performances, carried out in a businesslike way by automatic transmission. Dr. Muirhead and others have, we believe, also been working in the same field. There is no doubt that the time will come, at no distant date, when manual transmission will be entirely replaced on long cables by automatic transmission, owing to the increased speed attainable on account of the element of variability of signals, when controlled by different sending clerks, being thereby overcome.

Hitherto, five letters has been usually taken as the average length of a word, but Mr. Delany appears to be in the habit of taking seven letters to the word. He is, no doubt, correct in his assertion that this is nearer the average length when including code signals, but some universal understanding on this point should be come to for purposes of true comparison, as it is not always convenient to express the speed on a cable in terms of letters.

The New York *Electrical Engineer*, in reviewing Mr. Delany's performances, is mistaken in supposing that New York and London, working direct by sounder, formed a part of these experiments. The actual accomplishment was sending from Heart's Content over the new Anglo cable by Morse key and receiving in London, there being a special automatic repeater at Valentia.

Such experiments, however, scarcely lead one beyond the interesting stage (from a scientific point of view), for as the one great idea is to increase the working capacity of long cables for commercial purposes by means of automatic transmission, &c., it is not likely that we are going back to using the Morse or sounder in place of the recorder with the decreased speed thereby entailed; and after all it is only a question of speed, for it is common knowledge that a Morse recording instrument, or Vail sounder, will work through any length at some speed or another, if the required battery power be employed.

Another feature of Mr. Delany's experiments seems to have been signalling direct from London to Heart's Content with a repeating system at Valentia. This, again, is satisfactory as an interesting experiment, but we doubt whether the cable companies will see the force of connecting their cables direct with the landline to attain this object, involving as it does a separate land-line for each cable, and a working speed (by Morse) of about 14 words to the minute when one land-line can be made to do duty for several cables where the Wheatstone automatic is employed.

LOCAL ACTION IN ACCUMULATORS.*

By G. Darrieus.

In an article† that appeared recently, my old friend, M. Maurice Leroy, was kind enough to comment favourably on the results which I had published of experiments relating to the discharges of accumulator elements coupled in parallel.

He also very rightly showed the advantage there would be in carrying these experiments further, by repeating them on plates considered singly.

These reflections decided me to develop, sooner than I had intended, certain ideas, supported by figures, bearing on local action in accumulators.

These figures are not so numerous as I could have wished, several experiments, intended to complete those that I have already published on the subject, being in course of execution; but it seemed to me that there would be more advantage in publishing them now, and confirming them subsequently.

It is undeniable that the actions called local play a very important part in the accumulator, as indeed in any voltaic combination. It is known that they act upon the same electrode, and are due to want of homogeneousness in the metal or material forming this electrode, which gives rise, as a consequence, to the formation of elementary voltaic couples, having a very powerful action, owing to the circuit of these couples having practically no resistance.

The result is that there is a consumption of the material forming the battery, without any profit as regards electrical

* *L'Electricien.*
† See Electrical Review for November 9th, 1894.

energy. If we take, for instance, the zinc battery, we know that zinc which is chemically pure does not decompose cold water, or, at any rate, only very slightly. This is not the case, however, with the zinc of commerce, which, if plunged into water very slightly acidulated, is very violently attacked.

This difference is attributable to the presence in the zinc of commerce of various impurities, especially lead, which, together with the zinc, create a voltaic couple closed in short circuit.

It is interesting to remember that this phenomenon was the starting point of a system of accumulators, now forgotten, invented by M. D. Monnier, and which was obtained by forming an alloy of lead and zinc in definite proportions and then attacking it with an acid; when the zinc had disappeared a mass of spongy lead was left. In the case of the battery, the whole of the zinc dissolved by local action is consumed at sheer loss, and this is the very serious defect alluded to when we say of a voltaic combination that it expends or does not expend on open circuit.

There are many different kinds of local action, it is observable not only upon contact between the zinc and the liquid, but it may be set up between two liquids, or even in one only; it is in this way that the Bunsen battery, the nitric acid of which should be reduced to bioxide of nitrogen, gives off hypo-nitric acid in consequence of the reaction between the two first bodies. In the same way the bichromate sulphuric solution of the Poggendorff battery, if prepared too long beforehand, slowly decomposes. It is these various local actions that we propose to study in the accumulator.

We will first examine the composition of the accumulator, in order to form an idea of what kind of local action may be expected; for this purpose, we will analyse each electrode separately.

In the type of industrial accumulator now most generally adopted, the active material of the plates is applied by some process or other, either being spread on in the form of a paste, or attached by igneous fusion to a conducting support formed of an alloy of lead and antimony.

The object of this support, which is generally made in the form of a grid, is to distribute the current through the mass of active material, and it should not participate in the electrolytic action. The alloy of which it is composed should, therefore, be as little oxidisable as possible.

On the positive plate we shall thus get peroxide of lead on a grid of antimonious lead, and it can easily be seen that this heterogeneous mixture will develop a couple.

In short, by plunging into water containing sulphuric acid a small plate consisting only of peroxide solidified by compression and a portion of the grid, we get an electromotive force of 1·40 volts.

From these figures we draw a curious conclusion, viz., that peroxide of lead prepared in any manner and spread directly on a new grid, cannot give in the presence of a negative of spongy lead the normal electromotive force of the accumulator.

If, in fact, we subject a similar couple to measurement, we get for the electromotive force ·85 volt, a very variable value.

This low value explains how it is that certain experimentalists, having proceeded as described above, have thought themselves justified in concluding that the positive active material of the accumulator was not peroxide of lead.

Now, without taking into account chemical analyses which prove the absolute identity of the positive material with peroxide, we can arrive at the same conclusion by means of the following experiment:—

Into a little platinum capsule we put successively a small quantity of peroxide, obtained chemically, and then some electrolytic peroxide, and after having plunged the capsule into the acidulated water, with the same negative, we measure the electromotive forces; we find in both cases exactly the same value, 2·05 volts. The couple described above as being set up between the peroxide and the grid at once gives rise to a disturbing local action, in that it produces a lowering of the electromotive force.

There can be no doubt as to this being the case; to verify it we have only, before applying the peroxide to the grid, to oxidise the latter by plunging it into a boiling solution of hypo-sulphite of sodium; a superficial peroxidisation is produced which is sufficient to cause the positive plate formed with this grid to give 1·65 volts in the presence of a negative.

The chemical action here is limited, but if the grid is peroxidised by chemical means, and used as an anode before being spread with the paste, the plate gives with the same negative the normal electromotive force, 1·95 volts.

Other couples giving rise to local action are also generated in the very midst of the positive active material during the working.

We know, in short, that the principal reactions of the discharge have the effect of reducing the peroxide, which is brought back to a lower degree of oxidisation. Now, whatever may be the final limit of this de-oxidisation, there must exist a difference of potential between the peroxide which is not reduced and this weaker oxide. This is, in fact, clearly shown by the measurements taken after introducing in succession into the acidulated water peroxide and minium and peroxide and litharge. The electromotive forces of these couples are, respectively, ·85 volt and 1·04 volts.

I will confine myself for the present merely to showing the existence of these couples, but hope in a future article more completely worked out to draw some interesting conclusions from them. In the Planté couples there is also local action between the peroxide and the subjacent soft lead, and Planté utilised it to accelerate the formation. On the negative plate, when well charged, we have present spongy lead, and a support in the form of a grid, acting as conductor, composed of antimonious lead; we know from our former researches that there exists a difference of potential between the soft lead and the spongy lead; this should also be the case with the alloy forming the grid. If, in fact, we measure the electromotive force between a grid of antimonious lead and a paste of spongy lead, we get ·52 volt.

This couple, when short circuited, in which the active material is the negative, has the effect of accelerating the oxidisation of the spongy lead already produced by the mere immersion of the reduced lead into the acid liquid.

Lead in this peculiar molecular condition, being very active, decomposes cold water, and these two effects, one galvanic and one purely chemical, bring about the oxidisation of this active material. A similar action is set up in plates of the Planté type.

To these two causes together is due the slow but regular disengagement of bubbles of hydrogen on the negative plates of an accumulator at rest, which everyone that has manipulated these apparatus must have noticed. To this cause also is due the loss of charge, increasing as time goes on, in an apparatus on open circuit, supposed to be well insulated.

The electromotive forces of the different local couples which may exist on the electrodes in the course of the working of an accumulator are shown in the following table:—

Electromotive Forces of the Different Local Couples of an Accumulator.

Negatives.	Positives.			
	Peroxide of lead.	Litharge.	Alloy of lead and antimony.	Soft lead.
	Volts.	Volts.	Volts.	Volts.
Litharge	1·04	...	...	...
Alloy of lead and antimony	1·40	0·033	...	...
Soft lead	1·46	0·085	0·065	...
Spongy lead	1·94	0·51	0·52	0·46

In this too brief article I have tried to show that the local actions in the secondary couples are manifold, and that they are inherent to the physical structure of the electrodes. It is these parasitic actions that often mask the principal phenomena, and render experimental researches more difficult.

However this may be, the programme set forth by M. Leroy presents great interest, especially from a theoretical point of view, and agrees too well with that which I had mapped out for myself, for me not to try to carry out his suggestions shortly, by completing experiments already undertaken.

Is it not time to do something for these poor accumulators, which have been so decried and vilified, but which nevertheless are faithful servants when we know how to treat them?

THE TESTING AND INSPECTION OF ELECTRIC LIGHT CABLES.

[COMMUNICATED.]

I.

Now that so many town corporations are considering the question of electric lighting and the other uses to which electricity may be put, it will, perhaps, be opportune to give a few hints as to the way in which the cables and wires used for this purpose should be tested.

It is a matter for regret that consulting engineers attach so much importance to getting a certain number of megohms per mile, and yet utterly neglect in the majority of cases to specify that the cable shall be put to any electrical stress. The writer actually knows of one case in which cables were rejected on account of their being low in insulation (Ω per mile), although it was demonstrated to the inspecting engineer that they would withstand 100 per cent. more high-tension straining than that at which they were designed to work. A second lot of cables were made giving the correct Ω per mile, and these were passed without any straining being thought necessary; very little consideration will show how wrong this idea is in practice. It is, for instance, quite possible that one class of rubber should have a high specific insulation and yet offer very little resistance to a disruptive discharge, and it is a fact that a wire or strand covered with a high class compound rubber frequently gives less Ω per mile, or has a lower specific insulation resistance than the same wire covered with a cheaper or lower class compound, although, of course, the resistance of the former to disruptive discharge is far greater than that of the latter. A point not recognised by engineers as it should be is that a cable or wire takes far longer to recover from an electrical stress than is usually supposed, depending, of course, on the severity of the strain, it being frequently a question of an hour or more earthing before a reliable test can be taken to ascertain whether the insulation has diminished under the strain.

The actual methods of testing the insulation resistance of cables are well known, those most generally employed being the comparing the deflections obtained through the resistance which the dielectric represents at the end of a certain time, with those obtained through some known resistance such as 1 Ω or 10,000ω. This test is so well known that there is, perhaps, no need to enter into any description of it here; a few notes may, however, prove useful. The deflection should be quite steady, falling at a gradually decreasing rate throughout; should this not be so, two things are to be observed.

1st. Whether the unsteadiness is always positive.

2nd. Or sometimes positive and sometimes negative.

If the former is the case, the cable is probably faulty and should be carefully examined; if the latter, the cable is probably good, and the unsteadiness caused by a bad contact in the battery, and this, although the "constant" deflection may have been perfectly steady, the reason for this apparent anomaly is this: the Ω or 10,000ω through which the constant is taken is simply a dead resistance and not the seat of any E.M.F., and, therefore, an intermittent bad contact (and bad contacts of this class are usually very intermittent) simply means a very small resistance—compared with the 1 Ω or 10,000ω, being introduced into the circuit, and the alteration in deflection is correspondingly small and probably unobservable. A cable, however, may be looked upon as a condenser charged with an E.M.F. exactly equal to that of the cells; consequently, when the slightest fall in their E.M.F. takes place, the cable, to restore equilibrium, discharges itself of an equal amount through the insulation resistance of the cells, and in so doing produces a negative deflection, and on the cells recovering, a positive deflection will be observed, this being of course due to the fact that the cells are again charging the cable. These reversals may proceed very rapidly, thus making it appear, unless their meaning is understood, that the cable is faulty.

To ensure reliable results the ends of cables under test should be prepared with great care. For vulcanised rubber cables the following plan will be found a good one. The braid and tape should be carefully removed for about six inches, and the rubber thus exposed rubbed with a rag soaked in naphtha, a knife should then be scraped up and down the rubber with the flat of the blade at right angles to the length of the cable. This will remove all traces of the "proofing," or edge of the tape, which might otherwise cause surface leakage. The ends should then be thoroughly warmed in a spirit flame and tested, or, if the test is to be delayed, they should be dipped in melted paraffin.

The idea of testing the insulation resistance of cables on drums by throwing a bucket or two of water over them, is quite useless and very misleading. It is possible for a cable so tested to appear absolutely faulty, the same cable when tested under water being quite satisfactory. This is probably due to the fact that the cable never gets properly "electrified." The same effect, although in a lesser degree, will be observed when the cable has only been immersed a short time, and is more or less marked, depending on its general design. In fact, to obtain trustworthy results the standard 24 hours' immersion should never be lessened; and it is a debatable point whether even after this length of time the test would coincide with one taken after 100 or 200 hours' immersion, the particular design of cable under test also affecting this matter largely.

(*To be continued.*)

METHOD OF MEASURING ATMOSPHERIC RESISTANCE.*

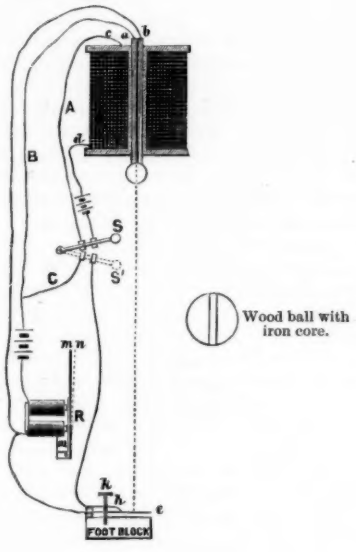
In the course of an interesting article in the November *Proceedings* of the Engineers' club, Philadelphia, on the measurement of atmospheric resistance, a method is described in which the beginning and ending of the interval are both recorded by the breaking of an electric circuit under precisely similar circumstances. By these means are avoided all uncertainties involved in the hysteresis of the recording magnet; the resistance of the circuit is practically the same for both circuits; the friction of the recording stylus is the same for both records—in short, any circumstance affecting the recording of one end of the interval will probably act with equal effect at the other end. Fortunately, however, there is no uncertainty even here, for if for any reason there is any difference, it is easily detected by the difference in the character of the curves drawn by the recording stylus when it flies back.

In the experiments described in the paper two balls were used. One was of soft Norwegian iron, carefully ground and polished to exact sphericity, with diameter of ·503 of an inch. The manufacture of the other ball cost much patient care and work. It was desired to have a ball that was truly spherical, of the same volume as the iron ball and yet of much less weight, to consist partly of iron so as to be attracted by a magnet, and finally to be perfectly symmetrical about its iron axis so as not to whirl while falling. This was accomplished with all necessary accuracy, as follows:—A cylinder of soft iron, about $\frac{3}{32}$-inch in diameter, and something over $\frac{1}{2}$ inch long, was carefully turned on a watchmaker's lathe. Without taking the piece out of the chuck, a block of white maple wood, a little over $\frac{1}{2}$ inch cube, with a hole drilled in it the size of the cylinder, was forced over the cylinder. Extreme care was taken that the cylinder was not bent or its centreing altered during the operation. The tail centre returned to its place perfectly immediately afterward. The turning of the wooden ball then began. Toward the last the ball was ground by means of a steel plate with a hole $\frac{1}{2}$ inch in diameter through it, the edges of the hole being very perfect. The tail centre was removed, the nub at that end carefully ground down until the sphere was perfect except its attachment to the chuck by a piece not more than $\frac{1}{16}$th inch in diameter. This was sawn off and finished with a file. The result was a ball measuring by micrometer callipers ·503 inch in every diameter, and hence of precisely the same volume as the iron ball, weighing less than one-fifth as much as the iron ball, with enough iron to be held by the magnet,

* *Western Electrician.*

and yet so symmetrical that when tested by dropping from a magnet to a piece of putty, it would invariably strike the putty with an orientation exactly parallel to that when hanging to the magnet. As it certainly could not whirl and invariably regain its original orientation immediately before striking, it probably did not whirl at all.

The accompanying diagram will show the principle of the apparatus employed. The core, *a b*, of the supporting magnet was made of concentric layers of thin, soft-iron (tin-type plate) in order to reduce hysteresis to a minimum. It was



then cut in two parts, and the two halves insulated by a sheet of rubber. When the switch, S, is in the position as shown in the cut, the core, *a b*, is magnetised, and the ball being placed in position, is held there by the magnet. When the switch, S, is turned to the position, S′, the current through circuit A being broken, the ball is free to fall. But while the ball hangs there, the ball itself (or the iron core of the wooden ball), closes circuit B, and the recording stylus, R, will be drawn to the position, *m*. When the circuit, B, is actually broken by the ball leaving the magnet, the stylus, R, will be forced back by the spring to *n*. When the switch, S, reaches the position S′, connection is again established through circuit C, and the stylus, R, is drawn back to *m*. When the ball reaches the "foot block" (about 8 feet below), the thin horizontal steel plate, *e*, is depressed slightly, and contact with the tongue, *h*, is broken, the current is again stopped and again the stylus is forced back to *n*. By means of the set-screw, *k* (which does not touch the plate *e*), the tongue, *h*, can be raised until it touches the plate, *e*, just enough to make electrical connection, and the merest touch of the plate, *e*, by the falling ball is enough to break the connection.

ELECTRICITY ON SHIPBOARD.

ALTHOUGH Great Britain, as has been pointed out in recent articles on the navy by the *Pall Mall Gazette*, should be foremost in energising in the direction of the efficiency of her "first line of defence," those who know something more about it than may be gleaned from the annual estimates are aware that she is sadly behindhand in almost everything. As regards guns, engines, and machinery, she might be presumed, in virtue of her superior industrial resources, to be *facile princeps* amongst the other sea powers; but this is, unfortunately, by no means the case if the considerations arising out of the hypothetical superiority which she should possess, compared with her contemporaries, be duly taken into account. As with armaments and machinery, so with those internal arrangements upon which so much of the fighting capacity of a man-of-war depends. The efficiency of electricity as a lighting, and especially as a motor power, has been recognised in a very perfunctory manner by the Admiralty, and, always speaking relatively, it is questionable whether we are not as much behind others in this respect as we are in the matter of guns and men. However, it is not the purpose of this article to supplement the admirable articles with which the *Pall Mall Gazette* is endeavouring to arouse the nation, but rather to call attention to what is going on in the American Navy, taking our cue from a recent paper by R. Dana Greene, late Ensign in the United States Navy, and Associate of the Society of Naval Architects and Marine Engineers of New York.

Mr. Greene dwelt upon the enormous increase in the practical applications of electricity on land, and expressed his satisfaction that electricity had at last been recognised as the proper agency for lighting on shipboard. This he regarded as a good sign, since all other applications of electricity would depend upon the lighting plant. The electric plants on board the U.S. Navy are, without doubt, the finest example of marine installations afloat, and it would be highly instructive to study them carefully. We commend this notion to the scientific advisers of the Admiralty, feeling confident that they will do nothing of the kind. In this paper, however, we can only touch upon the leading features of the electrical plant used in the U.S. Navy and mercantile marine, and to see what are the chief *desiderata*.

The plant is properly considered as one of the vitals of the ship, and should be always located below the protective deck in a compartment by itself, near the boilers, and as near the centre of the ship as possible. Engine and dynamo should be directly coupled, and the best practice is to provide a fixed coupling, readily accessible, between dynamo and engine. A reserve capacity should always be provided. In the U.S. Navy the reserve reaches 25 per cent. to 33⅓ per cent. of the full load duty of the plant, and is furnished by a separate unit.

Engines should be of the open type, compact and strong, with rigid frames, large bearing surfaces and liberal clearance in the cylinders. Vertical engines occupy much less deck space than horizontal, and are better adapted for ship service. The multipolar type of dynamo should be used, since it permits slow armature speed, less weight, greater compactness and closed magnetic circuit. Dynamos should be compound wound, insuring automatic regulation of the electromotive force with change of load, and should be provided with a field rheostat to compensate for the change in the resistance of the field winding, when hot or cold. Armature and fields should be most carefully insulated, and the insulation resistance of both should be carefully tested before the plant is accepted; it should not be less than 1 megohm. The maximum rise in temperature above the surrounding air (measured immediately after a full load test of not less than four hours) allowed in any part of the dynamo must be small, for high internal heat is certain to impair or ruin the insulation in time, and then the plant is useless without extensive repairs. The naval specifications are very rigid in this respect, the maximum temperature rise being only 50° F. This makes the dynamos expensive, and a limit of 60° to 70° F. can be allowed with reasonable safety in the merchant marine, unless the location of a plant is particularly unfavourable as to temperature and ventilation.

Dynamos and engines should always be tested together, as a complete unit. The full load efficiency of the unit, as measured by the ratio $\frac{\text{Electrical H.P. at dynamo terminals}}{\text{Indicated horse-power of engine}}$ should be not less than 80 per cent.; with the best types of marine sets it runs as high as 83 per cent. to 85 per cent. This applies to a unit with simple engine. The curve of efficiency falls off at light load, the efficiency being about 75 per cent. at ¾ load, 70 per cent. at ½ load, and 55 per cent. at ¼ load, and it should be arranged, therefore, that the units in operation at light loads should be loaded to at least 75 per cent. of the capacity.

The switchboard is an important accessory of the dynamo room, and, in common with all other appliances and devices used aboard ship, should be made of non-combustible material. The instruments and connections on the board should be accessible and compactly arranged, and the positive and

negative connections should be symmetrical. Any dynamo should be able to operate on any circuit, either single or in multiple, with the other dynamos. Switches for different dynamos and circuits should be plainly marked, so that the operator cannot make a mistake in their manipulation.

The wiring of a vessel is the most difficult and extensive, as well as the most important part of the installation. In Europe, it was the practice for several years to use the single conductor system of wiring, where one conductor only is run from the dynamo to the lamps, the hull of the vessel being utilised as the return conductor. The practice, however, has never found favour in America, and it has a number of serious faults, with the single argument of cheapness in its favour. Recent practice does not favour it, and the system generally used is the two-conductor insulated metallic return system. The wiring should be divided in separate circuits, lights which are located in the same parts of the ship, and which are ordinarily used at the same time, being grouped on the same circuit. These several circuits are then carried back to the switchboard in the dynamo room, where they are so connected that they can be independently controlled. In a merchant vessel, lights in the engine and fire rooms, cargo spaces, store rooms, and quarters should be on separate circuits, the subdivision of circuits being varied to suit individual vessels. On all exposed decks, and in boiler and engine rooms, cargo spaces, store rooms, and passengers' steerage, standard navy watertight mouldings and fittings (junction boxes, switches, &c.), should be used. In the quarters of officers and cabin passengers, standard non-combustible fittings, such as are used on shore, can be safely used.

The present standard navy wire has no lead covering. It was formerly required as a mechanical protection and waterproof covering of the wire, but it was found that in handling the wire aboard ship, the lead covering was very apt to become broken. The insulation of the wire should be depended upon to prevent troubles (the best rubber covered wire only being used), and a good heavy braiding affords all the mechanical protection needed, besides the moulding. The loss in the wiring should not exceed 5 per cent., and the expense is not excessive if this loss is limited to 3 per cent.

The electromotive force of all U.S. naval plants is 80 volts. This standard has been adopted in order to permit the use of search lights and incandescent lamps on the same dynamos without the interposition of too much dead resistance in the search light circuit; and as the search lights are an important part of the military equipment of a naval vessel, the adoption of a non-commercial voltage for the plant may be justified. But in merchant vessels no such important reason exists, and the voltage should range from 100 to 120 volts, so that commercial incandescent lamps can be used.

All wiring fittings and fixtures should be of bronze, or composition with bronze finish, no iron being used.

As to future developments, the electric motor is probably the most important direction in which we may look for it aboard ship. On a man-of-war it can be used to great advantage. Here are a few of the more important purposes to which it can be put:—1. For ammunition hoists. 2. For handling the turrets and the heavy guns placed in them. 3. For torpedo discharge apparatus. But for general purposes the electric motor will probably find plenty to do in the following ways:—1. For working ventilating machinery. 2. Portable drills. 3. Portable pumps. 4. Machinery in the engineers' workshops. 5. Deck hoists. 6. Operating the valve of steam steering engines, or replacing these engines altogether. 7. Opening and closing watertight doors. 8. Driving refrigerating machinery, &c., &c. We may also expect more developments in regard to search lights, range finders, night signalling, firing circuits, log observations, steering compasses, telephonic and bell signalling circuits, engine revolution counters and direction indicators, thermostatic coal bunker indicators, helm indicators, &c. In all these manifold directions America, to say nothing of France, is making more systematic progress than Great Britain is. Will it be necessary for us to suffer some great reverse in naval battle to awaken our sleepy Admiralty officials to the fact that the country is in danger because it is not attending to these minor matters of equipment, to say nothing of the guns and the men?

THE THACKERAY REFUSE DESTRUCTOR.

OUR contemporary, *Engineering News* of New York, describes a new form of destructor recently put to work in Montreal, for the purpose of destroying the refuse of one of the three city divisions, and of a capacity of 150 tons of miscellaneous rubbish per 24 hours. It consists of twelve cells placed in pairs, back to back, with grates, 5 feet by 6 feet. Each cell is apparently about 12 feet long on the grate surface. The back half of the grate is a grid, which receives the fresh rubbish shot into a hopper direct from the carts, while the front half is a rocking bar grate, on which combustion is supposed to take place. Thus the furnace door serves rather as an opening whence to remove the finished clinker, and the green rubbish is dried on the back grid by heat from the ash pit below.

The inclination of the grate is about 1 in 4 from back down to the front, so facilitating the movement of the rubbish towards the clinker doors, of which there are two to each cell. The ash pits, also, have large doors. Alternating with the large cells are fourteen smaller ones, placed between the walls of the large cells, with a view to being kept hot for burning the more refractory substances. Air pipes are placed in the flues, and through these is driven the air to the furnaces by a 90 inch fan. The blast is thus heated.

Ordinarily, the cell products pass into the main flue through two openings from the feed hopper, and pass through a boiler on their way to the chimney. This boiler is a small one only, of cylindrical type, 5 feet by 16 feet, and tubular, and placed so that it can be shut off from passage of the gases by swing dampers. There is stated to be a fume incinerator between the boiler and the chimney, or somewhere in the course of the flues not shown or clearly particularised. If thought necessary, the gases may be made to travel to the front of the large furnaces, and thence, after mixing with boiler steam, through openings in the furnace side walls to the bye-pass flues, the object of the admixture of steam being the more complete destruction of germs supposed possibly to have withstood any previous heat.

The result of this destructor is said to be satisfactory. On November 5th last, with 10 cells going, it dealt with 175 tons as against the contract amount of 125 tons. The contract calls for 150 tons to be burned for 90s. It actually costs a penny less than 80s. The cost on November 5th was 7d. per ton burned. Burning 29,000 pounds per cell per 24 hours the rate is 40·27 lbs. per square foot per hour. We may assume much of this fell through the grate as dust. The agreeable feature of this destructor is the small amount of boiler duty given it to perform as though there were a sensible appreciation that fuel once burned and mixed with rubbish is not a high-class fuel. What we do not like so well is the feeding of the refuse towards the fire. We should incline to think this would cook the stuff and give rise to fumes of noxious odour and quality. Nevertheless, the construction of the whole apparatus in brickwork, and the absence of any attempt to utilise the heat during the process of combustion, cannot fail to have an extremely good effect on the destruction if, indeed, it does not entirely prevent effluvium.

After all, the main purpose of a destructor is to destroy, not to generate steam, and this appears to be kept in view in the design of the Thackeray apparatus; but there is always the doubt as to perfection of destruction where the green refuse is fed at the rear of the furnace. Especially must the danger we allude to prevail or tend to prevail when the furnace door is opened for clinkering.

Code Telegrams.—As the result of a decision at the last meeting of the International Telegraph Conference (Paris, 1890), the International Telegraph Office at Berne was entrusted with the duty of preparing a vocabulary of words for use in code telegrams passing between European countries, to become obligatory three years from the date of publication. This vocabulary has now been issued, and contains over 250,000 words. A copy of it may be inspected at the Information Department of the London Chamber of Commerce, Botolph House, Eastcheap.

THE RECENT STORMS AND THE TELEGRAPHS.

There is a tradition in the Postal Telegraphs that at least one good storm is certain to come along about Christmas time. It may be that the inconvenience, to use no stronger term, that has at times been felt by the engineering staff of being out on the lines at the festive season, instead of spending it at home in comfort, has caused an exceptional experience to give rise to a general anticipation. However that may be, it is a fact that more than one of the storms that have become historic, from the telegraphic point of view, in recent years, have arisen about this time. The most disastrous of these was the great snowstorm of December 26th, 1886, when the telegraph service was practically paralysed throughout all the country south of Birmingham.

This winter the tradition has been doubly verified. There were two severe storms, one on December 21st and 22nd, just before, and a second on December 27th, 28th and 29th, just after Christmas. The former was of an exceptionally disastrous character, while the latter was probably only less so, because its maximum effects were felt in a district less thickly threaded with telegraph lines than that visited by the former.

The main effects of the earlier storm were felt in those portions of the United Kingdom bounded on the north by an imaginary line drawn through Edinburgh and Glasgow and out into the ocean; and on the south by a similar line drawn from Ipswich on the extreme east to Limerick on the west. All the great telegraphic centres lying within these boundaries were more or less affected. On the morning of Saturday, December 22nd, London was cut off completely from Scotland for a short time. Belfast had no cross channel communication by any route throughout the day, and Glasgow's only means of communication telegraphically during the early part of the day was on the comparatively speaking unimportant lines running northward. Every available man was at once put upon the repairing works, and so successfully were the breakdowns dealt with that by Monday evening, December 24th, all the main lines were got through temporarily and communication was restored between all centres.

In the Carlisle district the damage was great. All the important trunk lines were stopped, heavy damage being sustained both north and south of the town. During the 22nd and 23rd of December scores of fallen trees were cleared off the lines in this vicinity.

One remarkable circumstance was brought to light on December 23rd by the insulation tests on the railway line of Post Office wires between Wigan and Carlisle. The wires were known to be through, but no signals could be made to pass over them. On investigation it was found that the salt contained in the ocean spray carried inland by the storm had crystallised on the insulators both inside and out, and this, assisted by the general damp weather that prevailed, entirely broke down the insulation of the wires.

The wires in the Leeds district were very much knocked about, in fact it may perhaps be said that the effects of the storm were here most severely felt. The new heavy copper telephone line between Leeds and Barnsley was badly damaged in places. The main telegraph line between Leeds and Baldersley was broken down for half a mile at Chapel Allerton, and the Leeds-Harrogate line, which passes through a country containing much heavy timber, came in for an exceptional amount of punishment.

A curious fact to be noted with respect to the breakdowns around Leeds is that practically they all occurred between 7.30 and 9.30 a.m. on the 22nd. The "morning tests" showed all lines through with but few exceptions, but two hours later this important office had lost nearly all its main connections.

The storm of the 27th, 28th, and 29th December did no great harm over those portions of the kingdom most affected by the earlier storm. Its principal ravages were felt in the Scotch Highlands, where many of the scattered lines serving this sparsely populated district were a good deal damaged.

It is gratifying to know that in no case was a telegraph line wrecked, or a telegraph pole broken in consequence of the wind pressure against the structure itself. In all cases the breakdowns were attributable to falling trees, roofs, chimneys, &c., which in their descent fell foul of the wires and carried them down as well; in some instances also breaking poles. It does not necessarily follow, therefore, that the Postal Telegraph's poles and wires break or fall whenever the wind blows. If other structures—the works of nature or of man—maintain their proper positions, the telegraph lines could be very well left to look after themselves.

CENTRE POLES IN STREETS.

The current number of the *Street Railway Review* of Chicago ought to be in the hands of every member of the London County Council, in order to educate them to some idea of the actual facts as to the overhead system for electric tramways. The article which appears in our contemporary refers to the pious horror with which some people are apt to regard the pole system, especially when introduced upon residential streets; and those who are not in daily contact with the electrical lines are apt to have very hazy notions of what they really are. To give such people correct ideas, our contemporary illustrates a street in Evansville, an Indiana town, down the centre of which extends a line of trolley poles. These poles are light iron structures, carrying a cross arm, from which hang the trolley wires on either side of the pole to serve a double track of tramway. The arm is bracketed at its junction to the pole by light struts, and the whole presents an exceedingly neat appearance, while in a series of other pictures of streets as they would appear before and after the introduction of the poles, we are enabled to measure exactly the amount of the change they produce in the appearance of the street, and this is indeed very small. As regards the view from any one house, one pole is the maximum number directly visible at one time, and this one pole is no more obtrusive than a solitary lamp-post, to which we are all so accustomed as to take no note of its presence. We have heard a good deal of the obstruction caused by the trolley wires to the passage of fire escapes. If this difficulty were absolutely unsurmountable, there might be something in it. But the difficulty is not unsurmountable, and, indeed, is one hardly likely to make itself felt with the centre pole system, for there are no wires across the street. The trolley wires themselves simply rest on the cross arms, which are short, and there is absolutely no interference with the sides of the streets, and we do not see how any serious objection can be urged against them. But even, if for the sake of argument, it be admitted that there is some objection, say, an æsthetic one, against the trolley pole, what are we to say of the æsthetic objections, fiftyfold intensified, that urge themselves upon our senses wherever horses are employed. Any man with a shred of feeling in him cannot possibly watch the efforts of a team of horses hauling painfully upon a heavy tramcar under the scourge and hoarse shouts of callous drivers without a feeling of pain, while the sanitary aspect of horse traction is an equally powerful argument against its continuance. The fouling of the streets, and the filthy dust engendered in dry weather to the endangerment of eyesight, all call aloud for a change. Now, there will be no electric traction unless we can have the overhead system, and it is time that the people of this country bestirred themselves to prevent the choking of an industry that would find employment for thousands, and to put a stop to the check that is now placed upon the extension of tramways. We might here well take a lesson from American practice. With electrical cars running into and through the suburbs, the present disgraceful overcrowding of the suburban train service might be checked, and some relief obtained from the slowness, the dirt, incivility and discomfort which characterise most of the steam lines out of London. A horse tramline along one's own street is not now held to be desirable for, until such time as the property can be converted into business property, its value is, as residential property, reduced. But the same objection does not hold where an electrical road is concerned, for this would be welcome past every door. The prohibition of the overhead system by the London County Council is an infringement of the rights of the people to cheap travel, and one of the strongest proofs of the entire want of touch with the public and public opinion that has been afforded by the Council. It would appear as though

the whole Council were being led by the nose by the permanent officials who remained as a legacy from the old Board of Works, men utterly incompetent to form correct judgments on everyday affairs, and stuffed with exalted ideas of their own importance, which they endeavour to impress upon the world by vetoing every useful project. To impress themselves on people by doing useful work never seems to have occurred to them. The question for the people is this: Shall we suffer intolerable loss and inconvenience because an ignorant body of men choose to make our discomforts a stepping stone to their own self-fancied glorification?

The tramways are so essentially, even now, the means by which the poor man travels, that we think their scarcity, and the impossibility of extending them on electrical lines, must tell heavily against the mass of the people. It is the same in all our great cities. The tramlines run largely through the poorer districts, and, in a wide experience, we have observed that everywhere they are patronised by the people of moderate means. The peoples' professed representatives seem to think they have done their duty when they have provided brass bands to make the parks hideous and unbearable on what were once quiet Sundays. It is time this disregard of more important wants was stopped.

HIGHER VOLTAGE LAMPS FOR CENTRAL STATIONS.

By G. L. ADDENBROOKE.

The first portion of the following was written nearly two years ago, but as it then appeared a little speculative, it was withheld. Now, however, that the experiment is being tried in America, and lamps of even 250 volts pressure are being advertised, it assumes immediate practical importance.

Since the fundamental patents covering the manufacture of the incandescent lamp have expired, and lamps can be made and sold in bulk for 10d., it is worth while to consider carefully the bearing which the voltage of the lamps employed has on the problem of central station distribution, and whether some of the research which is now being expended in other directions might not more profitably be devoted to the endeavour to obtain a lamp which would prove efficient when worked at a higher pressure than is now regularly in use.

When incandescent lamps were first manufactured, they were commonly constructed to operate with a voltage of 20 to 30, or 40 volts. This limit was then raised to 50, 60 and 80 volts, and many early installations were laid down at these latter working pressures. Gradually, however, the limit crept upwards, and for large installations 100 and 110-volt 16 C.P. lamps came into use, especially for central station work. The normal working pressure might have been somewhat further extended, but that at this juncture a demand arose from the public for 8-candle lamps, largely in connection with the lighting from the then new central station at the Grosvenor Gallery. The Edison-Swan Company supplied 10 and 12-candle lamps under protest to meet this demand, but by declining to accept any responsibility, or to give any guarantees as to the working of their lamps, did all in their power to discourage their use. At the time there was reason for their action; the lamps presented great difficulties in manufacture, and were not even in quality or satisfactory in other ways. They, however, hit the public requirement at the time, and the public insisted on having them; consequently they were compulsorily made on rather a large scale, and as so frequently happens, continual practice has now led to a satisfactory 8 candle-lamp of 100 to 110 volts being supplied as an ordinary article of commerce, and under the usual conditions.

Had the lowest candle-power lamp in use remained the 16 C.P. lamp, it is probable that before this endeavours would have been made to employ higher voltages than 100 to 110 volts on central station distributing circuits, but the difficulty manufacturers have had in meeting the demand for an 8-candle lamp of 100 volts has deterred further progress so far, though there are many strong reasons for hoping that finality in this matter has not yet been reached.

How great a gain there is in distributing current at a higher voltage, and how much it simplifies the distribution problem, is not at first sight fully apparent, though everyone recognises that there are advantages. The advantages may really be said to progress as the cube of the voltage up to, say, about 200 volts. For let us suppose that we have a station, on all of whose circuits the lamps require 200 volts to incandesce them, instead of the usual 100 volts. In the first place, having doubled the pressure, we may extend our mains double the distance at the same current density with the same percentage loss; but at the higher voltage the same current density in a given sized main will give us twice the energy and light twice the number of lamps. Consequently, without increasing the sectional area of the mains, we can do four times the lighting with the same mains, or the same amount of lighting at four times the distance, with the *same percentage* loss. Then there is a further gain, for since we can extend the mains four times as far from the central station with the same percentage loss, the area which can be served from a single station is 16 times greater at the higher pressure than at the lower.

Presuming, however, that this argument is not pushed to its extreme limits, it is well within the mark to say that at 200 volts nine or ten times the area could be better served on the three-wire system from a single station than is now the case at 100 volts, and not only is this the case with the feeders, but it extends in an even greater degree to the distributing system. At present, there is no doubt that there is an inconvenient fall of voltage in the distributing mains, and in the internal wiring of houses, which leads to irregular and unsatisfactory lighting, and which is under existing circumstances, whatever system is employed, exceedingly difficult to remedy. If by any means the voltage could be increased to 200 volts this would practically vanish, distributing mains might be carried three times their present distance from the feeding point and the fall of potential in houses would be merely nominal on the present basis of wiring, instead of frequently amounting to 1—2 volts or more. By these means the number of feeding points in a given area would of course be much reduced. The same fittings and wiring as are now used would be applicable, and the voltage does not go beyond the Board of Trade limits.

Those who have had anything to do with the laying out of towns for electric lighting will often have felt how the ordinary three wire direct current system, though simplest and most desirable in many ways, seems as if it would just fulfil requirements. At a pressure of 200 volts (400 volts between the outer wire of the three-wire system) this would be entirely obviated, and a single station would, in most cases, serve town and suburbs, and allow an adequate control of the voltage over the whole area. The simplification and latitude which would be obtained under such circumstances are hardly to be gauged without practical experience.

What then stands between us and such a consummation? Nothing really of a substantial nature but the 8 candle-power lamp. For 16 C.P. lamps all that is necessary is to mount two 8-C.P. filaments of the ordinary 100-volt dimensions in the same bulb in series, or to use a filament of twice the usual length. It is true that such lamps would be rather more costly, and would wear out sooner than 100 volt lamps; but on the other hand lamps are now cheap, and it would certainly pay a low pressure station to make a reduced charge for the current, if such lamps were used in view of the saving of C^2R loss, capital in mains, and station management.

There is another important point in favour of the higher voltage lamp which has not yet been mentioned. From the tables of the lighting power of lamps under different pressures, by Dr. Fleming and Profs. Ayrton and Perry, I have compiled the following table, which is sufficiently accurate for ordinary purposes, and is easily remembered. Taking a lamp giving 16 candles at 100 volts pressure as a basis,

If pressure is		Candle-power of lamp
104 volts	... ...	20 candles.
103 „	... ...	19 „
102 „	... ...	18 „
101 „	... ...	17 „
100 „	(normal)	16 „
99 „	... ...	15 „
98 „	... ...	14 „
97 „	... ...	13 „
96 „	... ...	12 „

That is to say, that for 4 per cent. variations on each side

of the normal, every 1 per cent. variation in pressure makes about 5 per cent. to 6 per cent. variation in the light. Or 4 per cent. variation in pressure—the Board of Trade allowance—makes 25 per cent. difference in the light supplied. If, as is most frequently the case, the lamps are below pressure; then since it is light which the customer buys, 2 per cent. or 3 per cent. lowering of the pressure, which makes an inappreciable difference in the current registered by his meter, makes a difference of 10 per cent. to 15 per cent. in the amount of light the customer gets.

This is a serious question, particularly as the mains laid by the low pressure companies are getting gradually filled up. No one can fail to notice the differences in pressure in most low pressure circuits, and the frequent unsatisfactory nature of the light. The voltage of the lamps is usually much more even on alternating circuits fed from transformers; but, even in this case, it is desirable, if transformer stations are used, that they should not be too far apart, and that pains should be taken to keep the secondary pressure as constant as possible at consumers' premises.

This question of proper pressure is assuming greater importance owing to the perfection which has been attained by the incandescent gas light, and now that a careful inquiry by the *Lancet's* special commission has ascertained definitely that the lamps, while giving three times the candle-power, only consume half the gas, and give out half the carbonic acid that an ordinary burner does, and that there is practically no carbonic oxide or other deleterious product to speak of, it is pretty certain that their use will be largely extended, especially as it is perfectly clear that if there was keen competition the cost of installing the burners might be greatly reduced, and no doubt the cost of manufacture of the mantles, and their selling price will follow the same course, as has taken place with incandescent lamps, which have come down to less than one fourth the original price.

It is useless for electrical papers and engineers in this matter to copy the policy of the gas papers, and sneer at the incandescent gas light, as a matter of principle. The incandescent gas light has come to stay. It is certainly, as a light, decidedly superior to incandescent electric lighting, if the electric lamps are worked below pressure, and as it costs about half the price to instal that electric light does, and the mantles are about the same price as incandescent lamps, and last nearly as long, while the cost of gas is not one-third what has to be paid for electric current, even leaving out the extra candle-power secured, it is evident that there is much to be said in its favour, particularly as it is clear that it will have the whole financial backing of gas companies wherever they—which is not yet the case—are seriously menaced by the electric light.

There is room for both lamps for many years, and everyone should hail with pleasure the advent of a gas lamp which, easily installed, gives such a fine light with so much less injury to health than ordinary gas burners; it is a boon to the world, even if it does affect the pockets of electricians somewhat. The latter need not be alarmed; however; there is no question that an ordinary 16-candle 100-volt lamp, worked at 102 volts, is a pleasanter light, with, of course, an entire absence of deleterious products, and if lamps are kept well up to power, or slightly above it, from central stations, then the electric light will maintain its rate of progress; but if central station engineers, particularly those connected with low pressure stations, consider they have done their duty as long as they supply their customers with red hot hair pins of some sort, or a bright light when they don't require it, and next to none when they need it most, then their lamp increase *curves* will show a unpleasantly horizontal tendency over long periods.

The so-called 8-candle lamps should be systematically discouraged, and all means taken to induce customers to use 16-candle lamps as the minimum. These should be kept at their full brightness always, and means adopted to keep the pressure of the current always steady. Even the general adoption of 150-volt lamps—although a 250-volt 16-candle lamp advertised—would be a great gain in aiding this. A higher voltage lamp once secured, either for low or high pressure station, the whole central station distribution problem becomes simplified, and an important factor in cheapening further the cost of supplying current is secured. A higher voltage in customers' houses would also get rid, without extra outlay, of the annoying loss of pressure on customers' premises, which frequently amounts to 2 per cent., making a difference of 10 per cent. in the light given by lamps near the mains and at distant points.

The adoption of a 200-volt lamp would further give low pressure stations a new lease of life, and this is one of the reasons I have never been so enthusiastic an advocate of the alternating system as some people, although I have always considered that alternating currents are the best, and I am still inclined to think they will supersede continuous for almost every purpose. In the present case, however, the adoption of 200-volt lamps would be as advantageous for alternating stations, wherever sub-station distribution is employed, as for continuous.

All parties would therefore be gainers by the general adoption of 150 or 200-volt lamps, and as the Board of Trade could no doubt be induced to relax the distinction between the volts allowed for alternating and continuous currents in consumers' premises, there is nothing really formidable in the way of a change, especially in new stations now being inaugurated.

Where the three-wire system of distribution is employed, there is, of course, no difficulty whatever in installing 200-volt lamps right away, as is being done in America, and the sooner English engineers follow suit the better, especially as manufacturers of lamps cannot, of course, be expected to lay themselves out for the manufacture of the higher voltage lamps unless they are encouraged.

The gain which would be secured in distributing the current in residential suburbs, and the greater sphere for the adoption of the electric light which would be opened by the employment of 200-volt lamps hardly needs pointing out. In scattered districts or country towns the cost of the mains is the serious item in laying down a station; reduce this cost, say, to nearly half, including laying, at a stroke, while attaining greater powers of distribution, and the field for the economic production of electric current is largely extended, while the higher pressure would also be a gain for motor work.

It is the season for retrospects and forecasts; whether the change comes slowly or quickly is another matter, but I think there is little doubt that for the next few years the tendency will be to use higher voltages for electric distribution, and therefore the points raised in this article should have a place in the calculations of consulting and central station engineers in shaping their policy for the future.

DEVELOPMENT OF THE TELEGRAPHIC SYSTEM IN LONDON.

On the 3rd inst. an interesting gathering, chiefly of the members of the Metropolitan District Engineering Staff of the Postal Telegraphs, took place at the Mount Pleasant Factory, the occasion being the presentation of a testimonial to Mr. H. Eaton, on his retirement from the position of Superintending Engineer of the Metropolitan District. The gathering was presided over by Mr. C. F. Fleetwood, Assistant Superintending Engineer, there being also present—Mr. W. H. Preece, C.B., F.R.S., Mr. J. Hookey, Mr. J. Gavey, Mr. Martin Roberts, Mr. S. M. Banker, Mr. G. W. Hook, Mr. C. Porter, Mr. F. Shepherd, Mr. J. E. Bird, Mr. A. Johnston, Mr. A. Langman, and Mr. W. R. Smith.

After an appropriate introduction by Mr. Fleetwood, Mr. W. H. PREECE made the presentation, expressing the pleasure which it gave him to be present at the meeting, and the pain which he felt that the time had arrived when Mr. Eaton must sever himself from the service in which he had been engaged since 1846.

Mr. EATON, in acknowledging the presentation, said: Mr. Preece and gentlemen,—As this will, most likely, be the last opportunity I shall have of meeting so large a number of my fellow workers, it may be of some interest, at least to the younger ones, if I refer to some of the remembrances I have of what has taken place in the telegraph world during the long time I have been connected with it; and as that time dates as far back, if not farther, than any man now in active service can recall, I can perhaps claim, without boasting, to be somewhat of an authority on the subject. The Electric Telegraph Company was incorporated in 1846. I joined that company in the same year. Their first office was at No. 345, Strand. The works were at Limehouse, where poles and other stores were prepared for lines then being erected on some of the railways then in existence. About 1849 the company were in financial difficulties, and paid off a large number of their employés, I being one of them. Matters improved later on. I was again employed in the same company's service in 1851, and from that time down to the present have been continuously engaged on telegraph works. From 1851, onwards, telegraphs rapidly developed. Railways were being made in all directions, which gave telegraphs a

lift, as it soon became evident that railway traffic was facilitated and rendered more safe when controlled by telegraph communication. A rival company to the Electric started about 1851. That was the British; then came the Irish Magnetic, afterwards united with the former into one company under the combined name. As the Electric held most of the railways in England, the new companies found their field in Ireland, and, to some extent, in Scotland. The United Kingdom Company started about 1862 or 1863. Their basis was a uniform one shilling rate for 20 words, but this had to be modified some time afterwards, on account of the opposition of the older companies. General dissatisfaction at the manner public messages, &c., were transmitted led to proposals that the Government should take over the whole of the companies, which was ultimately accomplished in January, 1870. It will no doubt be more interesting to those I am now addressing if I sketch the progress made in lines and apparatus in London, and as my experience was greater with the Electric Company, I will limit my remarks to that company's progress prior to the transfer. Going back to 1851, the company's lines in London were underground. Overhouse telegraphs were then unknown (I think the first wire of that class was erected about 1860). For these underground lines cotton covered wire, drawn into lead pipes with Stockholm tar, was used, as gutta-percha had not come into use as an insulator. You occasionally come across sections of this old work. The difficulties with lead covered cables was with the joints, as seems to be likely to occur again with the form of cable now coming to use. The number of lines and mileage of wire was very limited at first. I remember when the whole of London was served by one double needle circuit. The lines led from the City or West Strand Office to the railway stations at London Bridge, Nine Elms (Waterloo came afterwards), Paddington, and Euston. King's Cross and Bishopsgate followed those named. The introduction of gutta-percha as an insulator gave the companies a material well adapted for underground work. Long lines were laid. The electric company laid lines from London to Manchester, Liverpool, and Leeds. These went *vid* the London and North Western Railway, but were so frequently interrupted and disturbed by railway works, that they were ultimately replaced by open wires. It would puzzle some of the present operators to read the signals which passed on the double needle instruments worked on these long underground lines. The reversing current system, known as the double current, had not then come into use. Prior to 1854, the only through route to Scotland was *vid* York and Newcastle to Edinburgh, and thence to Glasgow. There were only two wires, and, in bad weather, such weak signals, that the utmost care and close attention was needed to read them. In 1854 the company opened up the West Coast route *via* Carlisle to Glasgow and Edinburgh, and I was engaged in maintaining those wires on the Caledonian and other neighbouring lines, and remained in that district till 1862. On my return to London, in 1862, to take charge in the company's office in Telegraph Street, I found the progress in London had been very great. Telegraph Street had been built to supersede Founder's Court. Pneumatic tubes had been extended under the late Mr. Varley's guidance. The old double needle system had given way to printers on all important lines, and single needle apparatus was largely used for small offices, and on railways. It should be mentioned that the Electric Company maintained the bulk of telegraphs for the railway companies at that time. From about 1863 the agitation for the Government to take over the telegraph systems increased in force. The general dissatisfaction already mentioned became more marked, and the result was the Telegraphs Acts of 1868 and 1869, which authorised the Post Office to arrange with the companies accordingly. The late Mr. Scudamore was the Government representative in the business. Those of us who remember him, know the enormous energy he displayed, and his wonderful power of inspiring others to work. It fell to my lot to arrange for concentrating the lines of the several companies into the office in Telegraph Street. This was done without interruption to the working by the companies, and on the night of January 29th, 1870, the change was made. From January, 1870, to January, 1873, the amount of work done to provide for the removal from Telegraph Street to the present TS was very great, both as regards wires and pneumatic tubes. The story of the removal has been so often told, that it need not be referred to again, beyond saying that it was carried out without a single hitch, and without the slightest disturbance of the traffic, through wires and tubes. The success was entirely due to organisation beforehand, and the perfect way in which everyone did his part in the work. The centre room on the third floor was thought to be sufficient for the telegraphs. Mr. Scudamore had to be convinced to the contrary, even before we moved in. We took the four wings in addition, and occupied a large part of them at once, leaving space for growth in the several divisions. Where are we now? The whole area of the third floor, including what were separate rooms, has been absorbed, and a new floor built, which is also practically full. The tubes were shifted down to the central hall, and, when the Submarine Company's system was taken over, the large room on the second floor was occupied. As a fact, the telegraphs have squeezed out all other branches from the G.P.O. West, and proved the need for further new buildings. The New G.P.O. North is one of the results. Perhaps no part of the Postal Telegraph system has grown so rapidly as in London. Here everything centres. Any addition to lines always, or nearly always, affects London, more or less. All new forms of apparatus or other appliances are generally tried in London. It is needful for everyone to be on the alert to acquaint himself with all the novelties that are always being introduced. Our work is always progressing and expanding. When I look back to the simple forms of apparatus in use when I first began, and contrast them with the complicated machinery now in use, it is simply marvellous. Double needle led to printing. Then came the Wheatstone automatic, the Hughes type printer, duplex, quadruplex, multiplex, and, as my old friend Mr. Johnston said in his last article in the *St. Martin's Magazine*, to be followed probably by the "perplex." The introduction of telephones gave a tremendous impetus to telegraphic work. For commercial intercommunication, and perhaps for domestic work in the future, the telephone will largely supersede the telegraph. For private wire work much has been done. You know what has been done to perfect the police, fire brigade (including fire alarms), and other telegraphic and telephonic systems within the last few years. A volume might be written on the subject, but whether it would be read is another matter. People are so ready to accept all these things as matters of course; what is a wonder to-day will be taken up and used to-morrow as if it had been common property for ages. Summing up our own particular branch of scientific expansion, I do not think the postal telegraph system of our country can be beaten, and, as a parting word, I would urge upon you all to do do your best to make the London portion of that system a pattern for the whole world.

In conclusion, Mr. EATON expressed his hearty thanks to all present for the handsome way in which they had acknowledged his services.

Mr. BANKER, Mr. HOOK, Mr. COLLARD, Mr. BULL, Mr. FLEETWOOD, and Mr. PREECE having spoken, the proceedings terminated.

ELECTRIC LIGHT AS A THERAPEUTIC AND DIAGNOSTIC AGENT.*

BY MARGARET A. CLEAVES, M.D.,

Instructor in Electro-Therapeutics, New York; Post-Graduate Medical School, New York City; Fellow of the New York Academy of Medicine; Fellow of the Medical Society of the County of New York; Fellow of the American Electro-Therapeutic Association; Member of the New York Electrical Society.

THE attempt to illuminate the less accessible cavities of the human body had its origin as long ago as the beginning of the present century. Bozzoni, in 1805, first conceived the possibility of throwing light into the bladder, but without much success. In 1853, Desormeaux exhibited the first endoscope before the Paris Academy of Medicine. Julius Bruck, of Breslau, is said to have first employed the platinum loop as a source of illumination for medical work. In 1867 he exhibited a stomatoscope designed to assist in examining the rectum and bladder. These old instruments were cumbersome and inefficient, but Nitze and Leiter have constructed a cystoscope which has achieved remarkable success.

The use of the electric light in medicine now covers a much larger field, and has become an important aid in diagnosis. By it the dentist can detect spots of decay in the tooth, which without it would escape his observation. The nose and throat specialists are able to search the minutest recesses, while the physician who is in doubt regarding certain diseased conditions of the stomach and abdomen may literally study his obscure cases in a new light.

In 1885, Dr. Louis J. Lauterbach, of Philadelphia, published an account of the use of the incandescent electric light in examinations of the eye, ear, and throat. He recommended for illumination of the ear the use of a tiny lamp placed close to the speculum, and enclosed in a shield having a small circular opening in it.

In 1890, Theodor Heryng was able to illuminate the antrum of Highmore by using a 5-volt incandescent lamp attached to a tongue depressor. He was able in more than 30 cases to diagnosticate latent empyema without exploratory puncture, and this diagnosis was corroborated by the subsequent removal of the pus.

About two years ago, Davidsohn called attention to the value of illuminating the eyeball by an incandescent lamp in the mouth. Quite recently, Burger has claimed that luminous sensations in the eyeball were far more distinctive tests than illumination, as a very feeble light was sufficient to excite the subjective sensations.

On November, 1st, 1893, the writer had the pleasure of demonstrating this point to a number of physicians by introducing an incandescent lamp into the mouth. On the lamp being illuminated, the pupils of the eyes were seen as blood red apertures, and it was also shown that if the person so illuminated cast his eyes upward at an angle of 45°, he could discover the same phenomenon. Mr. N. Stevenson has called attention to the curious fact that when light is thus introduced the pupils do not contract.

Dr. D. Braden Kyle, of Philadelphia, has recently introduced some improvements for examining the nasal cavity. The essential feature of his method is the placing of the lamp within the post-nasal space, so that the parts are seen by direct instead of by reflected light. He also recommends that the lamp be protected with a cap of aluminium, by the aid of which it can be used continuously for 30 seconds without inconvenience from heat. This lamp was furnished by Charles Leutz, of Philadelphia.

Within the past few months, Dr. Chas. W. Caldwell has published an article in which he has considered the subject of trans-illumination of the mastoid cells as a means of diagnosis of *mastoiditis interna suppurativa*. The examination must be made in a perfectly dark room. When the lamp is inserted well into the external auditory meatus, and the current turned on, the healthy mastoid is illuminated with a red glow extending from the apex to the lateral sinus, and to the limits of the cells above. By placing the lamp on different parts of the mastoid, the limitation of the cells and the position of the

* Abstract of a committee report read before the American Electro-Therapeutic Association, September 27th, 1894.

lateral sinuses may be accurately mapped out, and pathological conditions demonstrated, if present. If there is a purulent condition in the cells, this portion will appear dark. Comparison with the opposite healthy side renders the diagnosis of pus in the mastoid cells complete, whether or not the usual symptoms are present.

The same observer has also described a method of trans-illuminating the accessory sinuses of the nose, by which he was able to detect a large mucous polypus by its translucency, higher refraction, and globular form, which concentrated the light and increased the brilliancy of the illuminated area.

Dr. Chevalier Jackson, of Pittsburgh, has also practised trans-illumination of the nose successfully for some time past. His method differs somewhat from that previously described, as he uses a 50 candle-power lamp and a hollow silvered glass rod.

As an instance of the great clinical value of electric illumination in diseases of the nose and throat, a case of tubercular laryngitis has been reported, in which no tubercle bacilli could be found in the expectoration, but on passing an applicator deeply down into the passages, under the guidance of a brilliant electric light, some secretion was found, which on removal proved to contain innumerable tubercle bacilli.

The work of Dr. Max Einhorn, in connection with the trans-illumination of the stomach, is well known. His "gastrodiaphane," first described in November, 1889, consists of a soft rubber stomach tube containing wire conductors, and having a small Edison incandescent lamp mounted at the gastric end of the tube. By its aid the examination is performed so quickly that there is no danger of the lamp becoming too hot, especially as the water in the stomach (swallowed by the patient just previously) exerts a cooling action upon it. Dr. D. D. Stewart, in the *Medical News* for February 18th, 1893, speaks of the value of gastrodiaphany as follows:—

"The actual utility of gastrodiaphany over other methods of outlining the stomach lies especially in the application of the diaphanoscope to the differentiation of gastroptosis and gastrectasia, as by it the determination of the site of the lesser curvature is far more readily made than by inflation."

Theodor Heryng has succeeded in trans-illuminating the anterior walls of the vagina. With the help of a Ferguson speculum he was also able to insert an electric apparatus into the rectum and so trans-illuminate the posterior wall of the vagina as far as the posterior fornix.

With reference to apparatus, it is a matter for regret that much of the intended experimental work has not been done on account of the great difficulty experienced in securing suitable lamps.

The W. F. Ford Surgical Instrument Company furnishes a lamp for trans-illumination of the frontal sinuses, also one for the trans-illumination of the antrum of Highmore.

The Galvano-Faradic Manufacturing Company have furnished a small mouth lamp for general use.

The use of a lamp has also been secured for the trans-illumination of the bowel, known as Heryng's lamp, and a lamp for the trans-illumination of the pelvic tissues devised by myself.

These lamps have all been personally tested with the following results:—

*Ford's head lamp requires 10½ volts and 1 ampère, and gives 3 candle-power. For use with street current, it should be placed in circuit with one 16 and one 24 candle-power lamp. Ford's lamp for the trans-illumination of the frontal sinuses requires 8 volts and ·8 ampère, and gives about 2 candle-power. For use with street current two 16 candle-power lamps should be placed in circuit. Ford's antrum lamp requires 8 volts and ·8 ampère, and gives a little over 2 candle-power. For use with the street current, one 16 and one 24 candle-power lamps are needed. The lamp supplied by the Galvano-Faradic Company requires 5½ volts and ·8 ampère, and gives a little over 1 candle-power. For use with street current it requires two 16 candle-power lamps in circuit. Heryng's lamp for trans-illumination of the bowels has a shield or cap over it with an attachment to a fountain syringe, so that water is allowed to flow about the lamp and also through the terminal opening into the bowel itself. It requires 9 volts and ·7 ampère, and gives a little over 2 candle-power.

The lamp for the trans-illumination of the pelvic tissues, devised by myself, requires 32 volts and ·8 ampère giving about 8 candle-power. It was a 20 candle-power lamp, but as it passed through a chapter of accidents, it is at present only an 8 candle-power, but will be replaced shortly by one of 20 candle-power. This lamp† is also a water lamp, the water flowing in and around the lamp, and distending the walls of the vagina by a device similar to my new water electrode. The lamps variously used, and the results obtained from them, have already been indicated in the report. The Edison lamp or condenser, for direct illumination of the different cavities of the body, has also been tested. It is particularly suited to positions in which the direct rays of light may be used, and is also satisfactory where the light has to be reflected.

So far as the trans-illumination of the bowel is concerned, nothing has as yet been done. I have made, however, a number of observations in trans-illumination of the pelvic tissues. As a result of these I have found that wherever there is morbid material, either in the form of exudative matter or abnormal growths, as fibroid tumours, sarcoma, &c., the tissues of the anterior pelvic and abdominal walls are not trans-illuminated, but remain absolutely black. In the abnormal conditions which have been examined, the pelvic cavity has been pretty well filled, so that there has been no trans-illumination. Of course, with the morbid material on one side only, the other side should be trans-illuminated. In so far as I have done any work in this direction, I regard trans-illumination of the pelvic organs of rather doubtful utility. The conditions can be much more accurately determined by means of the educated finger than by any candle-power of electric light that has yet been used.

I have been able to obtain translucency of the tissues within 2 inches of the umbilicus, but have demonstrated nothing save the course of the blood vessels.

The foregoing statements give a fair idea of the use of electric light in diagnosis, but they by no means compass all the methods by means of which electric light is helpful in therapeutics. One of the recent adaptations is known as the electric light bath, and is based on the proposition that the properties of electric light are similar to those of sunlight. By means of a suitably constructed cabinet, patients are subjected to the rays of a number of incandescent lamps. The temperature can be regulated by passing the current through a resistance coil, and may vary between 90° and 150° F., with a result equivalent to a combined light and vapour bath. The skin is browned as if by sun burn, and the effect is claimed to be most salutary.

The writer has had placed in her hands for use an apparatus furnished by a manufacturer from Newark, which is worthy of attention as a means of experimental work. It is a cabinet with an arc light arranged in front of a large tin reflector, which can be raised or lowered at will. This and a lamp with a very strong lens and reflector for localisation of the rays of light are the only apparatus which have been placed at my disposal. It is impossible, therefore, to say which form of apparatus is best, but owing to the production of ozone by the arc light, I would give it the preference. No observations have yet been made as to the efficacy of the light used through glass or similar substances, nor have investigations been attempted which would enable me to arrive at any conclusion as to possible difference in therapeutic effect between electric light and solar light.

Turning, now, to a consideration of the effect of light on living organisms, we find that plants have been forced into rapid growth by exposure to the rays of the electric light. M. D'Arsonval has made many investigations on the effect of both sunlight and electric light on various bacterial growths. He found that cultures exposed to the white rays were not coloured, while those exposed to the red rays had developed pigment. He also expressed the opinion that light exerted a more powerful influence over bacteria than ozone, or even oxygen.

Dr. H. Marshall Ward, in a paper read before the Royal Society, showed the effect of light on bacilli from the Thames, and found that in all cases both solar and electric spectra exerted no perceptible action whatever in the infra-red, red, orange or yellow region, while all the bacteria were injured or destroyed by the rays from the blue or violet spectrum. The intervention of a thin piece of glass resulted in cutting off a large proportion of the effective rays. The most distinctive rays, *i.e.*, those at the end of the blue and beginning of the violet, were to some extent effective, even after reflection from the inner faces of a quartz plate covering the film, and the glass on which it was supported. This investigator goes on to say that these results evidently suggest that the naked arc light may prove to be a very efficient disinfecting agent for use in hospital wards, railway carriages, and other places where the rays could be projected directly on the organisms.

Theodor Geisler, in 1892, found no qualitative difference between sunlight and electric light, only a quantitative difference. In the course of some experiments on the typhoid bacillus, he found the most decided effect was produced by the rays from the violet end of the spectrum.

P. A. Khmelevsky, of St. Petersburg, after prolonged experiments, concluded that both solar and electric light have an undoubted inhibitory influence on the growth of microbes.

Klebs-Loeffler has discovered that diffused light does not prevent the development of cultures of diphtheria at ordinary temperatures, or at a temperature as high as 95° F., but that sunlight arrests this development, and after an exposure of several days, sterilises bouillon. This bactericidal power of light towards the bacillus of diphtheria is due almost exclusively to the rays of greatest refraction, those at the other end of the spectrum having little or no action of this kind.

Some years ago experiments were made with Jablochkoff candles in the Paris sewers, with the result that considerable purifying action was noted.

In 1881 (?) Mr. Harold P. Brown, E.E., of New York, while using Brush arc lamps for lighting the basement of a store in Chicago, noted that within an hour after turning on the current, the odour from the closets which at first was very offensive, became entirely neutralised.

The writer, who has an arc light apparatus in her office, such as has been described, made the following observation on a recent excessively hot day. The refuse barrels which had accumulated in the basement over Sunday, and had not been removed Monday morning, emitted a very unpleasant odour, which filled the office. The arc light was turned on and the writer left the room for half an hour. On her return, she found that every evidence of odour had disappeared, and that the air seemed perfectly pure, while in another part of the house, which was not near enough to be affected by the light, the odour still persisted as before. This action was undoubtedly due to the ozone.

In an article in the *Medical Week* for August 17th, 1894, Dr. R. L. Boqies gives some interesting facts regarding the influence of solar rays on the skin, and concludes that some other principle must be at work beside heat. Some observations of M. Charcot tend in the same direction. The phenomenon appears to be due to the action of the chemical rays in the ultra-violet end of the spectrum. Mr. H. B. Hewetson, in the *British Medical Journal* for 1893, cites five cases in which the eyes became inflamed after watching the operation of electric wiring by the arc light, unless the observer was protected by a shield of thick ruby glass. It was found that the skin of the face and neck would become tanned, and would peel off just as if it had been exposed to the rays of the sun. This was evidently not due to heat, but to the chemical rays.

* None of these lamps were tested by a photometer, but were made with a voltmeter and ammeter.

† See *Medical Record*, August 25th, 1894, page 252.

M. Gautier has recently investigated a curious phenomenon, namely, that substances which have been submitted to the action of electricity, or which have been exposed to the direct rays of the sun, are in a peculiar state of excitement, which renders them much more active as regards one another than are the same substances prepared by the ordinary methods of the laboratory.

Such being the admitted facts, one is prepared for the assertion that electric light may be made a potent therapeutic agent Dr. Gatchkowski, St. Petersburg, 1892, reports 27 cases, chiefly of rheumatic and neuralgic pain, which he had quickly cured by the electric light, and Stanislaus von Stein also reports good results.

Few observations have yet been made by the writer as to the therapeutic value of electric light. Something, however, has been done, as the following particulars will show. In one case of cervico occipital neuralgia of great severity, coupled with supra-orbital neuralgia, the application of the electric light was found to be exceedingly grateful to the patient, and resulted in relief from pain for several hours. In a case of intense pain in the roots of the cervical cord, an extension of neuritis, the only way the patient was able to get sleep without hypnotics, was by having an electric lamp placed directly over the cervical cord. In this instance, however, it is believed that the heat only produced this grateful result.

The following experimental observation is reported somewhat at length:—

J. C.; 21 years of age; a stenographer; suffering from anæmia and enuresis. The electric arc light bath was given for 20 minutes. The patient was placed upon a stool within the cabinet, with the entire body exposed to the rays of light, special attention being paid to localising it at the lumbar and sacral plexuses. The treatment was entirely experimental, but with the expectation of at least improving the nutrition. The writer felt willing to undertake it, as she was confident of being able later on to cure the enuresis by long, percussive static sparks. The patient had suffered from nocturnal enuresis as far back as she could remember. Menstruation was established at 17, and was perfectly regular. All the conditions were normal, save that the patient was decidedly anæmic, and suffered from facial acne; the pupils were always dilated, and there was a tendency to constipation, the bowels often moving but once in two days—rarely two or three days consecutively. The wet nights were slightly variable; she would sometimes go in summer two or three nights without trouble, but rarely for this time in winter. In all, 16 treatments were given, extending over a period of one and a-half months, three times weekly. Careful examinations of the urine were made at first, and the pulse temperature and skin were carefully watched. Thirteen observations were taken of the temperature and pulse. In eleven instances the pulse dropped, and it was always of better volume after the bath. In two instances the pulse remained unchanged, but with improved volume; while in every instance (13 times) there was a rise in the temperature of from ·1° to ·8°. The skin always became moist under the applications, and during the last treatment perspiration was very profuse. There was a general sense of well-being expressed by the patient after each application. Soon after coming under treatment the bowels became regular, and there was no trouble during the time she was under care, nor since then, a matter of nearly six months, excepting for a few days at one time after discontinuance of treatment, when very much hurried, making preparations for leaving the city. She was slightly constipated. The urine was analysed from time to time, and showed a steady increase in the amount of urea eliminated. The patient gained a pound and a-half during the first two weeks, and since that time has gained seven pounds more, and is in better health than for several years. The temperature of the bath varied on different days, being affected by the outside temperature, but ranged from 90° to 100° F. The patient always left the office feeling much better. No drug of any sort was given or allowed the patient during the time she was under observation.

Arrangements have just been made with a dermatologist to have observations made as to the value of arc light in parasitic skin disease, and, in fact, to carry out a systematic series of scientific experiments bearing upon these points. The writer is well aware that the value of one or two experimental cases is open to question, but under the special circumstances already referred to, has thought well to mention the few cases quoted, wishing it to be distinctly understood that she considers the investigation very incomplete in its present stage.

It is interesting to note that Dr. Dawson Tyner,* of London, commenting upon the well known treatment of goitre by smearing the part with red iodide of mercury ointment, and then exposing the surface to direct sunlight, suggests that the effect is due to the power of iodine to cut off the visible rays of the spectrum. The fact that red iodide is the more efficacious points in this direction, for it would serve to transmit the heat rays only. In this way the part is subjected to the full blaze of the calorific rays, without the vibrations of its molecules being altered by the visible rays. If this theory be correct, we could expose diseased parts to sunlight or to a fire after the application of iodine. May not this suggestion give us a valuable hint in connection with the use of the electric light bath.

And now, after studying this novel and interesting subject until we have begun to form some adequate conception of the potency of light, we are confronted with the rather startling announcement, from no less a physicist than Prof. Dolbear, that there is no such thing as light—that there are no peculiar waves which can be called light. In proof of this assertion, he describes a method of taking a photograph of an object in absolute darkness by means of the ether waves set up by working an electrical machine. We have already seen how similar are the effects of sunlight and the electric light, but lest there should still be a lingering doubt in the minds of some individuals regarding this point, that distinguished experimenter, Nikola Tesla, comes forward and produces a faint glow of light in a dark room with alternating currents of 800,000 voltage by means of atmospheric vibrations, to such an extent, that the phenomenon would no longer be electricity, but *light!*

* We fail to find this name in the Medical Directory. It is probably intended for Dr. Dawson Turner, of Edinburgh.—EDS. ELEC. REV.

CORRESPONDENCE.

Design of Small Dynamos.

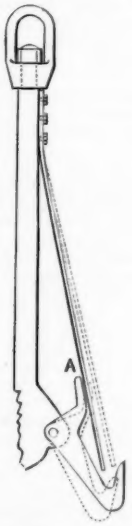
I enclose rough sketch of "upright" Kapp dynamo which I am making, and would be obliged if you will kindly say if the proportions are right, or what improvements you can suggest; also, how would you "wind" for best results for "incandescence" lighting and "accumulator" charging.

Fitter.

[At 1,500 revolutions you will require 300 turns of wire on the armature to give 100 volts. Field magnets winding may be two coils of about 15 ohms each, coupled in series with each other, and as a shunt on the armature. No. 18 wire will come near this resistance. The design is fairly good so far as it is shown.—EDS. ELEC. REV.]

Submarine Cable Grapnels.

On reading the description of Mr. Claude Johnson's new collapsible grapnel for rocky bottom, it occurred to me that additional efficiency would be secured if, besides the toes receding behind the umbrella shield, the shield itself were made to advance, and, so to say, lift the grapnel off the obstruction. I enclose you a rough sketch, which will, perhaps,



show my idea. The guards are not of the same form as Mr. Johnson's, but are similar to those employed by Mance in his patent No. 5,808, of 1885, and have sufficient spring in them to give the small movement necessary. There is no reason, however, why there should not be a conical guard inside them, extending down to the heel of the toe at A. The dotted lines are intended to show the position of the toe and guard just as a rock has been cleared. I think the arrangement would be more efficient, and it is certainly simpler and less costly.

XXX.

January 4th, 1895.

Explosions in Underground Mains.

I have read with interest the leaderette in your last issue on this question, and quite agree with you that such occurrences are real misfortunes to electric lighting. It is more to be regretted, in my opinion, as such accidents might easily have been avoided had better attention been given to the

question of ventilating and drainage of culverts and boxes at the time of construction. I recognised the importance of this some years ago, and when, under my charge, the mains were laid in the streets of Southampton, and afterwards at Hull, the culverts were constructed with a fall in every case to an inspection service or junction box, from which any water was easily pumped as it accumulated, which was very slowly. The bottom of the box was sunk deeper than the culverts, and, in some cases, a separate "catch-pit," deeper than this, was constructed outside the junction box, and covered by a small cast-iron lid. The question of ventilation is much simpler than it appears to be to some engineers, judging from the report of the inquiry into the Cannon Street accident, and the best that I have seen is that carried out at Hull (the idea of Mr. F. H. Lewis). From each junction box an earthenware pipe is led to an ordinary drain box of the same material let into the ground as close as possible to the nearest wall; on the top of this is fixed a cast-iron cover with small holes all over it. These holes are cast with a lip or ridge round them, which successfully prevents much water running in. It was found that during the first six months, and, for all I know to this day, very little attention of any kind was needed, and a current of air was always passing through the culverts. It would not be a very difficult or expensive matter to adopt something of the kind in London. Even where buried mains are used, the inspection and junction boxes could be treated in this way.

When these matters are carefully attended to a better insulation will be given to the mains, and water and gas disarmed, so far as their power to cause explosions are concerned.

B. H. Jenkinson, A.M.Inst.E.E.

January 9th, 1895.

Primary Batteries.

Having always been much interested in electrical matters, so far as they can be studied and investigated at home, and having given a good deal of attention to the study of the best forms of practical primary cells, I am induced to approach you on the subject, and particularise a form or two which are, perhaps, worthy of mention.

I have found that, by placing the negative element edgewise to the Zn, the available current and its constancy is increased. The reason for this, I take to be, the doubling of the active surface. The electrolyte, by this arrangement, has a much freer circulation. Take an example: In the ordinary bichromate cell the plates, of course, are arranged as in fig. 1. Now, if the carbons are split (as it were) and

Fig. 1.

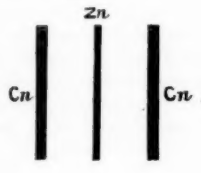
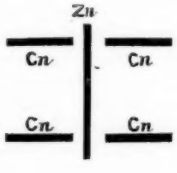


Fig. 2.



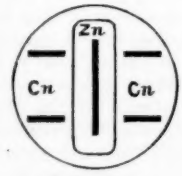


Fig. 3.

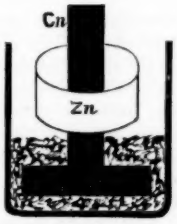


Fig. 4.

arranged *edgewise* (fig. 2), a decided advantage will be gained both in regard to current and in regard to constancy, for both sides of the carbons are now in an active position. In the first arrangement, the remote surfaces of the carbons are inactive, and do not contribute, noticeably, to the efficiency of the couple.

By this *edgewise* arrangement of Cn plates in cells, where broken carbon is used in the outside cell, very good contact is obtained, and, consequently, large surface with low resistance.

An efficient bichromate cell (fig. 3), embodying this principle, I have arranged as follows:—A flat porous pot, containing the Zn and dilute SO_4 H_2, is placed inside a cylindrical outer cell with four carbon plates, placed edgewise, packed with broken carbon.

The Leclanchè (fig. 4) I also arrange on a similar plan. In the centre of an outer cell I put a flat carbon, to the bottom of which I attach, by means of a rubber ring or two, another carbon plate, crosswise, and then half fill the cell with the peroxide Mn mixture, and then support a short circular Zn plate above from a wooden cover.

The carbon plate crosswise at the bottom ensures good contact in the mixture. No *p. p.* is required, so consequently the resistance is very low.

If you consider these modifications of cells merit mention in the Electrical Review, others may be glad of the suggestions.

Alf. Jno. Paine.

Incandescent Gas Burner.

I have read with considerable interest the article on the incandescent gas light system in your issue of the 4th inst. I send you by this post copy of the *Lancet* of the 5th inst., on page 51 of which you will find a report on our system of lighting. A comparison of the two is instructive.

L. de Fonblanque.

[We are much obliged to our correspondent for sending us a copy of the *Lancet*, which, however, we had already seen. If a comparison of the report of our contemporary with our article of the 4th inst. was found of considerable interest, our next week's comments on the egregious blunders into which the *Lancet* has fallen will be more so.—Eds. Elec. Rev.]

NOTES.

Personal.—We are pleased to notice that Mr. W. J. Furse, electrical engineer of Nottingham, has been elected Chairman of the West Bridgford District Council. This appointment carries with it a seat on the Magistrates' Bench for the County of Nottingham.

We understand that Mr. Stephen Sellon has resigned his appointment with the Electric Construction Company, Limited.

We learn that Mr. J. S. Cunnington, who has been for over 10 years chief electrical engineer and manager to the electrical department of B. Verity & Sons, Covent Garden, W.C., has now severed his connection with them.

Carbide of Calcium.—Prof. Henry Morton, of the Stevens Institute of Technology, writes to *Engineering* as follows:—"The electric furnace has recently been applied to mixtures of lime and coal dust, with the result of producing a compound before unknown to chemistry, *i.e.*, carbide of calcium. This substance, as it comes from the electric furnace, is a slag-like mass, in parts showing a crystalline fracture with a lustre like felspar. Its remarkable property is, that on contact with water, it develops a large volume of gas, which appears to be mainly acetylene. Thus, if a fragment of this rock-like mineral is sprinkled with drops of water, gas is given off, which, if ignited, continues to burn, so that by simply dipping the fingers in water and throwing a few drops from time to time on this *stone*, it will continue to blaze until entirely converted into lime. By introducing a quantity of this carbide of calcium into a closed vessel connected with an automatically regulated water supply, gas available for illumination can be readily generated under any desired pressure. Whether the cost of producing this compound in the electric furnace would be such as to allow of its industrial application, remains to be proved; but it would be of use in certain cases where the economic question was not controlling, and it is certainly a very curious compound."

Extensions at Manchester.—In accordance with a special resolution of the Town Council, it is proposed to borrow £100,000 to carry out extensions. It will be remembered, no doubt, that the plant originally put down was to supply 20,000 16-C.P. lamps; since then, however, it had been necessary to make provision for a further 8,000 8-C.P. Customers now represent 27,000 16-C.P., and more are asking for light.

New Companies in 1894.—The *Investors' Guardian* of the 5th inst. publishes some particulars relative to limited companies registered at Somerset House during the past 12 months. The following figures are given of electric and telephone companies:—Electric: Total for 1892, £1,596,825; total for 1893, £2,045,500; total for 1894, £2,387,107. Telephone: Total for 1892, £260,000; total for 1893, £31,000; total for 1894, £236,000. In a statement of the companies registered during the first and second halves of 1894, our contemporary remarks that, considering the improvement in business in the late autumn, it may appear somewhat surprising that the increase in the companies registered during the second six months is not greater. Electric: First six months of 1894, £1,969,500; second six months of 1894, £417,607; total for 1894, £2,387,107. Telephone: First six months of 1894, £220,000; second six months of 1894, £16,000; total for 1894, £236,000. Another table compares each class with the corresponding figures in 1892 and 1893:—Electric: Total for 1892, £1,596,825; total for 1893, £2,045,500; total for 1894, £2,387,107. Telephone: Total for 1892, £260,000; total for 1893, £31,000; total for 1894, £236,000.

The Fusion of the French Telegraph Companies.—Some interesting details of the above have now been published. We extract those relating to values of cables, &c.:—*Société Française des Télégraphes Sous-Marins.*—The capital in 1888, when the company was formed, was 5,500,000 francs (£218,250), and with this was laid the original system of about 1,000 miles, in four sections, between Cuba, Mole St. Nicholas, Puerto Plata, Curaçoa, and La Guaira. Additional capital to the extent of 11,000,000 francs (£436,310) was raised early in 1890, in order to construct a second system of about 2,700 miles, commencing at Puerto Plata and extending to Brazil *viâ* Martinique, Paramaribo, and Cayenne, and also branch lines from Mole St. Nicholas to Port au Prince, and from Martinique to Guadaloupe and Marie Galante. This completed the West Indian system so far as for the moment was possible. The company next, in 1893, turned its attention to the Pacific, and laid a cable of some 780 miles in length between Australia and New Caledonia, raising for the purpose the sum of 4,000,000 francs (£158,730). The total capital actually amounts to about £814,000, and the mileage of cables to 4,453. The cost per mile is, therefore, £182 16s., while the cables of the Western and Brazilian, the Cuba Submarine, and the West India and Panama Companies are stated to have cost £301 8s., £205 2s., and £294 2s., respectively. The present value of the society's cables is taken on the basis of a 25 to 30 years' life. The total value of subsidies received yearly is £26,000, or 3·2 per cent. on the capital. *Compagnie Française de Paris à New York.*—This company's cables consist of a section of 2,291 miles between Brest and St. Pierre, with branches from St. Pierre to Cape Cod and to Cape Canso of 885 miles and 239 miles, respectively. They also possess a cable from Brest to Penzance of 164 miles, and land lines in the States of a length of 346 miles. They are also the owners of the repairing steamer, *Pouyer-Quertier*. The company was floated in 1879 with a capital of £1,666,666 (42 million francs), and the submarine cables alone are said to have cost £856,600, or £239 7s. a mile; their present value, after 15 years, is taken at one-half, or £428,300, and the value of the *Pouyer-Quertier* has been reduced from £40,000 to £31,500. The landlines, which cost £15,873, are now valued at £11,904. Houses at Brest, St. Pierre, and Cape Cod, which cost £4,127, are now valued at 10 per cent. less. Stores, instruments at stations, furniture, cable stores, and spare cable bring up the total value of the company's property to 12,779,500 francs. The sum actually agreed upon by the two companies is 14,000,000 francs (£555,555).

A Slight Explosion in Glasgow.—Explosions are becoming of daily occurrence. One happened the other day in Glasgow; it was, fortunately a slight one, but they all count. We do not think for a moment that these explosions reflect in the slightest degree on the managers of the electrical works, but again we must ask for concerted action in this pressing matter.

Wonderful.—A young man from Australia has just come to London to astonish the natives, and for that purpose he has fixed some induction coils and vacuum tube apparatus, which he has recently tried upon a guileless *Evening News* man, who says "he found himself in a blaze of electricity," and by merely touching a button, "all the glass tubes became illuminated in colours, the names of which have probably not yet been invented." It is much more wonderful to us that newspapers do not avail themselves of the services of a competent electrician to report on the "wonderful" things brought before them in the electrical line. The names of the colours seen by the amazed newspaper man may have yet to be invented, but the name applicable to a man who conjures with very ordinary electrical apparatus is too well known to require mention here; it is neither "scientist" nor "electrician."

Australian Cable and Mail Contracts.—A Dalziel's despatch of January 3rd says an inter-Colonial Conference will be held on February 12th to consider the situation created by the decision of the Victorian Government to withdraw from the guarantee given to the Eastern Extension Telegraph Company by all the Australasian colonies except Queensland, and in virtue of which the charges for cable messages were materially reduced. The Postmaster-General expresses the opinion that the colony's withdrawal from participation in the cable subsidy will not render it necessary for the Eastern Extension Telegraph Company to raise the tariff for the transmission of messages to the old figure. Pressure is, however, being brought to bear by New Zealand and the other colonies to induce the Victorian Government to reconsider their decision.

Gas v. Electricity at Chester.—A little quarrel has broken out at Chester between Mr. Alderman Churton, the Mayor of Chester, and the chairman of the gas company on the respective merits of electricity and Chester gas. The Mayor, who appears to have the courage of his opinions, stated at a meeting of the Town Council that the gas was very bad, and had been bad for some time. In his own house he could not see. The chairman of the gas company objects to this view of the matter, and states, in correspondence which has appeared in the local paper, that the gas was above the standard which they are called upon to supply. In his letter the chairman goes out of his way to attack electric lighting, but the Mayor is equally ready to repel the onslaught. Such episodes are good for electric lighting; they bring public attention to bear on the matter, and with only one result.

The Cardiff Electrical Works.—Mr. Sydney F. Walker writes to us that in our issue of December 28th, 1894, we gave an illustration purporting to represent his works, which, he says, does not represent them. He also complains that its publication, with the accompanying letterpress, is calculated to injure his business. "If the publication," he continues, "was made under a misapprehension, it is a very simple matter for you to make the usual *amende*. If, on the other hand, the publication was made with the deliberate intention of injuring my business, as I shall naturally infer if you refuse, I propose to bring an action against you for libel." The illustration was given as a view of Mr. Walker's works, and was copied by process from a photograph, one of four in our possession, and if Mr. Walker thinks the photographer has not done his works justice, we shall be pleased to supplement our previous illustration if he will send us a better print. We are surprised Mr. Walker should have thought that we had any intention to injure his business, and cannot imagine that our remarks could be so construed by any impartial person. Certainly we had no such intention.

Society of Arts.—On Monday next, January 14th, at 8 p.m., the first of a series of Cantor Lectures on "The Arc Light," will be delivered by Prof. Silvanus P. Thompson, D.Sc., F.R.S. He will deal with the Discovery of the electric arc light—Early experiments—The physics of the arc. On Wednesday, January 16th, at 8 p.m., a lecture will be delivered on "Commercial Synthesis of Illuminating Hydro-Carbons," by Prof. Vivian B. Lewes. Dr. William Anderson, F.R.S., will preside.

Storage Batteries.—Mr. Hancock, of Cardiff, again writes :—"Your remarks to my note gives me the impression that the P.D. term is not generally understood, as you say, whatever that may mean. The P.D., as I know it, is the E.M.F. measured by voltmeter when current is flowing, as compared with E.M.F. of cell. The E.P.S. discharge, as I know it, is 4 ampères per + plate of lighting type. If I discharge at 4 ampères, the P.D. will be 10 per cent. of 2 volts. That rate only holds good providing the cell is in proper condition, and will almost discharge out by the time its E.M.F. falls to 1·8 ; any increase on 4 ampères is sure to damage plates in time." Mr. Hancock's impression is erroneous. "Whatever that may mean" did not refer to P.D. *per se*, but to the then unintelligible context.

Elliott's Smoke Annihilator.—We noticed in the *Standard* of Wednesday a page advertisement of Elliott's Smoke and Fumes Annihilator. It consists mainly of opinions (!) of the newspaper Press, and of testimonials from residents of Newbury, from whence Mr. Samuel Elliott hails. Half a dozen technical papers are quoted, and we cannot help giving the extract from our contemporary, the *Electrician*, as one of the "opinions of the Press, unanimous in its favour." The *Electrician*, December 1st, 1893, says :—"Mr. Elliott claims that his new invention goes far towards solving the great smoke problem." We have referred to the issue in question, and find that no opinion whatsoever is expressed in favour of Elliott's apparatus. The *opinion* of the Electrical Review is not advertised, but intending investors in the invention which is to purify blackest England might with advantage refer to page 4 of our issue of July 4th, 1890, unless, indeed, vast improvements of which we know nothing have been introduced.

The Management of the Worcester Electrical Works.—There has been a good deal of trouble in electing an electrical engineer for Worcester. A special meeting of the Worcester City Council was held on Monday, for the purpose of considering the proposal of the Electricity Committee to appoint an electrical engineer. At the previous meeting the Council, by a majority of one, did not accept the committee's recommendation to appoint an electrical engineer, but referred the matter back. Thereupon the committee resigned, but the Council declined to accept their resignations. The committee again met, and, having reconsidered the matter, came to an "intensified conviction of the imperative necessity for the appointment of an engineer having experience in the management of electric light, to devote his whole time to taking entire charge of the works and installation." In bringing up this report, Mr. Williamson maintained the necessity of the appointment being made, because it was physically impossible for Mr. Caink, the city surveyor, to perform all the duties with which he had been saddled. He moved that Mr. Murray, of Aberdeen, be appointed, and that Mr. Caink's position be considered by a special committee. The Sheriff seconded. Mr. Rushton moved, and Mr. Lewis seconded, an amendment that having appointed Mr. Caink, it was considered undesirable to appoint another engineer. After a long discussion, 20 voted for the amendment and 20 against it. Alderman Stallard did not vote. The Mayor gave his casting vote against the amendment, which was therefore lost. Mr. Hughes then moved that on the appointment of Mr. Murray, Mr. Caink be relieved of his duties as an electrical engineer, and a reduction of his salary be considered. Mr. Williamson agreed, and this was added as a rider to his original motion ; Mr. Cook seconding. Mr. Barnett moved, as a further amendment, and Alderman Higgs seconded, that any appointment be deferred for three months. This was lost by 18 votes to 22. Mr. Williamson's motion—with Mr. Hughes's rider—was then put and carried by 22 to 18. Mr. Murray was therefore elected.

The Northern Society of Electrical Engineers.—At the meeting to be held at the Palatine Hotel, Hunt's Bank, Manchester, on Monday, January 14th, Mr. Henry Edmunds will deliver his Presidential Address.

The Electrical Standardising, Testing, and Training Institution.—Yesterday, Thursday, the 10th inst., Mr. James Swinburne commenced a series of lectures to the students of the above Institution on "Dynamo and Transformer Construction."

The Salary of the Burnley Engineer.—The Gas and Electric Lighting Committee, at a recent meeting of the Town Council, recommended that the salary of Mr. Thursfield, the electrical engineer, be increased from £150 to £200. Mr. Tempest, the socialist member, naturally protested against paying anything, but the storm passed over, and the committee's recommendation was accepted.

Sic transit gloria mundi. — It was ever thus, and the two Clydebank youths who for a whole month or more have set Glasgow by the ears with their wonderful primary battery, can now retire as gracefully as circumstances will allow into the obscurity from whence they came. H. N. Warren, of H. N. Warren & Co., certified analytical and research analysts, who conduct the Liverpool Research Laboratory, sends us the following, in which we have carefully preserved the writer's style :—

We forward you a copy of the latest improvement in voltaic electricity which is appearing in all the scientific papers of stand, and trust you will insert the sam as early as possible please oblige with *a copy of your paper* when *inserted together* with scale *of advertisements* and oblige, if not inserted return manuscript to above address.

Then comes the copy which is appearing in all the scientific papers of stand (*sic*) :—

A Revolution in Voltaic Electricity.

The Boron Carbon Battery, by H. N. Warren.

The numerous cells that are constantly described upon the pages of scientific literature, and after all which are so modest as regards their voltage, naturally suggests an apology to offer yet another. The above title does not however stand too foremost, when I may mention that after a lengthy, and troublesome research, the author has had the satisfaction of arranging a battery capable of producing 3 volts, and giving a constant current from 2 to 2·5 volts for almost unlimited duration. Such a battery may be in some way approached by either Bunsen, or Grove's cell, but in mine there is a complete absence of fuming acid, and costs less than one penny for 10 hours action; the cells themselves are constructed upon the flat system, with sliding carbon plates, enclosed in teak wood boxes, the carbons being chemically prepared by special treatment, whereby gaseous compounds of boron, are so decomposed as to allow of the boron becoming absorbed in the pores of the carbon, which are afterwards soaked in solution of oxalate of platinum and heated to redness in an atmosphere of hydrogen. A flat porous cell encloses the zinc element, while the outer cell contains a specially prepared manganic salt in admixture with other substances.

The cells are for several reasons arranged in a series of three, and thus readily constructed for either voltage, or quantity, and complete up to 50 amperes, the cost at the commencement being no greater than batteries that afford only half the power. As illustrative of the power of these particular cells, twelve small ones were arranged in a series; the arc produced between the carbon points; being more than the naked eye could bear, over two feet of platinum wire were raised to incandesence, whilst the heat produced from the arc readily fused titanium, tungsten, and chromium, and volatilized platinum in quantity; a series of fifty of most batteries would have failed to have accomplished it; as a lighting agent for large, or small lamps, they stand unrivalled, whilst the absence of fumes allows of their presence in dwellings, conservatories, or places of a like nature, for driving motors one cell is usually sufficient; whilst on the other hand for electro chemical demonstration 3 cells will be found sufficient for the entire work of a large laboratory.

Everton Research Laboratory,
18, Albion Street, Everton, Liverpool.

This is certainly the first time we have heard of a battery producing a *current* of 2 to 2·5 *volts* for almost unlimited duration. The modest allusion to Bunsen and Grove shows that Mr. Warren has some appreciation of previous workers in the primary battery field, but they never produced a cell capable of giving 3 volts. So far as the remaining points are concerned, we fail to find anything whatever to support Mr. Warren's claims that he has gone further than dozens of other primary battery designers, for, if at the initial stage the arrangement of the cell gives a high result, we fancy that there would be very soon, as in the case of a Smee, a great falling off. Many a time and oft have we shown these apparatus as they are, not as the inventors would have them, and if Mr. Warren will send us a battery, we will give it our careful attention.

Euston Road Explosion.—The Board of Trade inquiry was opened by Major Cardew at St. Pancras Vestry Hall yesterday. Prof. Robinson and Mr. Prosser appeared on behalf of the Vestry. We shall give a full report in our next issue.

Lecture.—Before the Manchester Society of Architects, a few days ago, Mr. E. A. Claremont (of F. H. Royce & Co., Limited), read a paper on "Electric Lighting."

The Institution of Electrical Engineers.—Students' Meeting.—On Friday next, at 8 p.m., the following paper will be read:—"Electrical Transmission of Power" (with special reference to mining operations), by Henry F. Haws.

North-East Coast Institution of Engineers and Shipbuilders.—On Tuesday, January 15th, 1895, at 7.30 p.m., a paper on "The Design and Efficiency of Plant for the Transmission of Power by Electricity" will be read by Mr. W. C. Mountain. It will be illustrated by limelight.

Boat Disaster.—The disastrous fire which occurred on a ferry-boat near Nictheroy, last Sunday, is now stated to have been caused by an electricmotor. A telegram from Rio de Janeiro says that the boat was named *Terceira*, and plied between Rio de Janeiro and Nictheroy. She left the latter place on Sunday evening with 200 passengers, but had not proceeded far when the fire broke out, and the majority of those on board perished.

The Telephone in America.—The Berliner patent, deposited in 1877 and issued in 1891, has been declared void by the Circuit Court of the United States, on the grounds that another patent for substantially the same invention had already been granted to the same patentee, and that the owners of the patent contributed to the delay in the issuing thereof. The assumption is that the Telephone Company, being already protected by the Bell patent, had not used due diligence in the prosecution of "interference" cases, with the result that the Berliner patent did not "issue" until the approaching expiry of the Bell patent. As the Berliner patent controls the microphonic principle in its application to the transmission of speech, the effect of its validity would have been to continue the telephone monopoly for a number of years. Unless the decision of the Circuit Court should be reversed on appeal, such monopoly will be avoided.

BUSINESS NOTICES, &c.

Aberdeen.—The Finance Committee have not yet had time to look into the tenders for electric lighting, but have remitted them to the electrical engineer to see whether they conform to the specifications.

Battersea.—It has been resolved by the vestry to oppose the entry of companies into the district, and a committee has been appointed to consider the cost of plant for supplying the parish.

Belfast.—The report of the Electric Lighting Committee presented the other day, stated that considerable progress has been made with the central station, and the committee expected to supply electric current in the month of January.

Chard.—At a recent meeting of the Corporation the idea of using the water-power from the Chard reservoir for electric lighting purposes was discussed.

Fareham.—The District Council, which has superseded the Local Board, is about to overhaul the decision of the late authority in favour of purchasing the electric lighting company's works. A Local Government enquiry has been held, but it is proposed to ask the Local Government Board to withdraw their sanction to the proposed borrowing of £7,000 by the authority.

Hastings.—Judging from what the *Hastings Times* says, things do not appear to go altogether smoothly:—"When the Council," says our contemporary, "were induced to adopt electric lighting for the Front Line, it was distinctly upon the understanding that the plant had been so improved as to make failure of the illuminant impossible. It is, unfortunately, however, a matter of too frequent occurrence recently that the light does go out and leave the Parade in darkness. The Council must be fully alive to the fact that this sort of thing is exceedingly harmful to the town. Having from the first earnestly urged the Corporation to substitute electric light for gas, we are sorry to see that it is not yet all that can be desired. We must hope that whatever defects are accountable for this deficiency will be speedily remedied."

Ireland.—Mr. Maurice Pitman, A.M.I.E.E., of Sandymount, County Dublin, has secured the following contracts:—Belfast:—The lighting of the Great Northern Railway Company's goods yard, Belfast, with four arc lamps of 2,000 nominal C.P. each. Dundalk:—The lighting of new dining car for the Great Northern Railway Company, "Ireland" which is now being built at their works, Dundalk. This car will be fitted with about 20 lamps of 5 C.P. each, including fittings, and a battery of E.P.S. accumulators. This carriage will be lighted either by its own accumulators or from a set of E.P.S. in guard's van, which serve to light several electrically lit carriages, which cells are charged by a dynamo driven off axle of guard's van. Dublin:—The lighting of Messrs. M. & S. Eaton, wholesale and retail stationers, 49, Dame Street, and 8, Grafton Street, Dublin. Both shops will be lit by incandescent lamps, current being supplied from mains of the Dublin Corporation Electric Supply.

Llanelly.—The Corporation are discussing the question of lighting the streets and the Town Hall by electricity. Tradesmen are being also circularised with a view to ascertaining the feeling on the subject of private lighting.

Liverpool.—As a result of a long discussion on Wednesday, the Liverpool City Council adopted, by 29 votes to 13, a recommendation of the special Lighting Committee that the council offer to purchase from the Liverpool Electric Supply Company, Limited, the whole undertaking of the company as a going concern this year, instead of waiting until the period when the Corporation could compel the company to sell, at price, terms, and conditions as may be agreed upon between the company and the committee, and, failing such agreement, as may be settled by arbitration. The committee were authorised to take the necessary steps to carry out the objects of the resolution. Alderman Forwood said if arbitration were resorted to, he would not be surprised if the company preferred a claim for £500,000, and he deprecated giving the committee what might be called a blank cheque.

London.—At the Commissioners of Sewers meeting on 8th inst., it was stated that the Streets Committee are considering how the cost of the electric lighting of the public streets can be reduced.

Maidstone.—A motion, that the Council should invite tenders for the purchase of their electric lighting order, was postponed till the next meeting.

Morecambe.—Owing to the numerous complaints of vibration which has been made during the past twelve months, the Morecambe Company have at last resolved to remove their works to another site, where they will be free from indictments for nuisance.

Queenstown.—The chairman of the Town Commissioners intends proposing the appointment of a competent electrical engineer to report upon the practicability of lighting Queenstown by electricity, by using the present pumping station machinery.

Southsea.—Elm Grove Baptist Church, Southsea, is lighted by electricity, and the other Sunday evening while the service was proceeding the light suddenly went out. The pastor's subject was "The candle of the wicked shall be put out," &c., &c. At the approach of such a discourse the modest light blushed for very shame, then flickered and went out.

Stafford.—We understand that Messrs. Drake & Gorham have been entrusted with the electric lighting of the County Technical Instruction Buildings, now in course of erection. The number of lights will be nearly 300.

Watford.—Mr. Frederick Downer, photographer and photo-etcher of this town, has this winter had the electric light put into his show gallery. This is the first shop electrically lighted in the town. The generating plant being situated some distance from the gallery, on the opposite side of the High Street, at his photo-etching works, the mains are carried overhead across the street, permission having been granted to do this by the then Local Board (who, it will be remembered, vetoed a private electric supply company starting in the town). The current is used both for arc and incandescent lighting, arc lamps having to be employed in the "process" work, while only incandescent are used at the galleries.

A Big Alternator.—The London Electric Supply Corporation, Limited, has ordered from Messrs. S. Z. de Ferranti, Limited, of Charterhouse Square, a 1,000-unit alternator, to work at 10,000 volts. It is to be at work in the Deptford Station within seven months. The machine will be of the old pattern, and similar to that just built for Sheffield, that is, without iron in the armature, but the field magnets will have the faces capped with ebonite upon Mr. Ferranti's patented system for high tension work. This is to prevent sparking from the armature, as the 10,000 volts will pump an air space of about $\frac{5}{8}$-inch, which, without this precaution, would make the clearance space unworkable. The engine for driving is a three-crank compound, coupled direct to the alternator shaft, and will be supplied by Messrs. Plenty, of Newbury. Although nominally for 1,000 units, the machine is actually constructed for an E.M.F. up to 11,000 volts, with a current of 100 ampères.

A General Electric Match Box.—The General Electric Company have sent us as a New Year's greeting a neat lucifer holder made from stone. It is matchless in its way.

Agency.—Messrs. Ellis & Ward, of 113, Edmund Street, Birmingham, inform us that they have been appointed agents in that town for the Brush Electrical Engineering Company, Limited. The two members of the firm were formerly connected with the London branch of the company.

Attempted Robbery.—At Clerkenwell on Saturday, Frederick Finn, 23, carman, of Stamford Street, Blackfriars Road, was charged with being concerned with two other men in breaking into the warehouse, 3, Playhouse Yard, St. Luke's, with intent to commit a felony; and, further, with maliciously wounding James Robison, a Commissionaire. James Willey, managing director of the London Electric Wire Company, said the injured man Robison, who was unable to attend the Court, was a watchman in the company's employ at 3, Playhouse Yard. Witness was called to the premises late on Friday evening, and found that a pair of folding doors leading to the warehouse had been forced open. Police-constable 285 G said that between 8 and 9 o'clock on Friday evening he was called to the company's premises and saw there the prisoner and two other men, whose escape Robison was trying hard to prevent. A long and severe struggle took place between the officer and Robison and the three burglars, during which a lighted candle was blown out. Robison was then thrown violently to the ground and disabled. Witness, however, held on to Finn, who made desperate efforts to escape, but in vain. The other two men succeeded in getting away, and dropped a formidable "jemmy" in their flight. During the struggle the prisoner shouted to his companions, "Out with your knives and cut their throats." Robison, it was stated, was brutally beaten on the head with a "jemmy," and lost a large quantity of blood. The prisoner was remanded.

Code Telegraphy.—As the result of a decision arrived at at the last meeting of the International Telegraph Conference (Paris 1890), the International Telegraph Office at Berne were entrusted with the duty of preparing a vocabulary of words for use in code telegrams passing between European countries, to become obligatory three years from the date of publication. This vocabulary has now been issued, containing over 250,000 words, and a copy of it may be inspected on application and presentation of business card at the Information Department of the London Chamber of Commerce, Botolph House, Eastcheap.

Dissolutions of Partnerships.—The *London Gazette* contains a notice to the effect that the partnership heretofore subsisting between E. H. Berry and P. C. Pope, carrying on business as electrical engineers and contractors at Burnley, Lancs., under the style or firm of E. H. Berry & Pope has been dissolved by mutual consent as and from December 24th, 1894. All debts due to and owing by the said late firm will be received and paid by the said E. H. Berry, who will in future carry on the said business on his own account under the style or firm of E. H. Berry & Pope.

The *London Gazette* also notifies that the partnership which has for some time past been carried on by S. Breuell the younger and D. J. Callow, at Pier Place, Chiswick, under the firm of Callow, Breuell and Co., in the trade or business of electrical engineers, has been dissolved by mutual consent as from August 28th, 1894.

Notice has been issued of the dissolution of partnership in the firm of Browning & Gardner, electrical engineers, 44, George Street, Edinburgh, dating from December 12th, 1894. Mr. C. M. Gardner is now sole partner.

Electric Wire Casings.—Messrs. Viger Bros., timber merchants, have sent us a card illustrating style and size of their electric light casings.

Embezzlement From an Electrical Firm.—Eldred James Goodwin, 22, was brought up in custody on New Year's day on a charge of stealing £2 11s., belonging to his employers, Messrs. John Bryden & Sons, electricians, of Gloucester Road, South Kensington. As it appeared that there was a deficiency in the accounts amounting to £113 8s. 6d., the prisoner was further charged, at the suggestion of the magistrate, with embezzling that sum Mr. F. J. Bryden said the prisoner had been in their service as clerk for eight years. On the 21st of last month he discharged him as he was not satisfied with the way in which he had been performing his duties lately. On Tuesday he spoke to him about the accounts, and he then produced a list and said he had appropriated the money. The accounts were all for work done last year. The prisoner pleaded guilty, and said he was very sorry. Mr. Rose: Can you tell me the circumstances under which you appropriated the money? The Prisoner: Bad company and living beyond my means. Detective-sergeant Ham said he had known the prisoner for several years as a respectable young man, but recently he had been betting. Mr. Rose said it was very deplorable that after eight years' good character prisoner should lose it by going into bad company and betting. He committed him to prison for two months, with hard labour.

Lighting of Hampstead Vestry Stone Yard.—Mr. Frederic H. Taylor's tender amounting to £68, for fitting up buildings in the stoneyard for the electric light, has been accepted.

Lighting of Places of Worship.—The Bishop Street Wesleyan Chapel, Leicester, has been successfully equipped for electric lighting by the Corporation gas and electric lighting department.

Lighting of the Leeds Town Hall.—The arrangements between the Corporation and the House-to-House Company for lighting the Town Hall, which we said in our last issue were in a state of *pendente lite*, have been now concluded, and the building will be at once connected to the company's mains.

Linder Dynamo Machines.—From the *Elektro-Mekaniska Aktiebolaget Norden*, of Stockholm, we have received an illustrated sheet of the Linder dynamo-machines, electro-motors, electro-depositing dynamos, &c.

May's Speed Counter and Chronograph.—Messrs. O. Berend & Co. are placing upon the market a new speed counter and chronograph combined in one instrument, which indicates revolutions and time to a fifth of a second. Among the advantages claimed are that the instrument serves as a tachometer for measuring and determining irregular speeds, and that the works of the chronograph are non-magnetisable, readings therefore being absolutely correct when taken from a dynamo or electromotor.

New Branch.—Mr. W. J. Lister, of Rivers Mills, Dursley, informs us that he has started, in addition to his own business of general engineering and ironfounding, a branch business, the name of which is "The Lister Electric Light and Power Manufacturing Company," and the address the same as given above.

New Firm.—Messrs. F. A. Glover & Co. have started business at 97, Queen Victoria Street, London, E.C., as electric light engineers and contractors.

Personal.—Mr. Fred Bathurst, who for the last four years has been in America with the Edison Electric General Company, has now returned to England for the purpose of developing the interior conduit system of electric wiring. The Interior Conduit and Insulation Company, of New York (Mr. E. H. Johnson, President), has practically the monopoly of conduit work in America, and as the use of the conduit is universal, it is really saying that this company supplies the material used in every important installation carried out in the States. The system has already been very successfully developed in Germany by Messrs. S. Bergmann & Co., of Berlin, and is rapidly becoming acknowledged in that country as the standard method of electric wiring. Mr. Bathurst hopes to bring its merits before English wiring contractors. His office arrangements are not yet matured, but any enquiries may be made to his private address, No. 14, Greencroft Gardens, South Hampstead, N.W.

Progress in Bath.—We recorded last week two or three instances of provincial progress in electric lighting, we have now to mention that electric lighting matters are looking up in Bath, the lamp connection at the moment being over 8,000 8-C.P. lamps.

Roger Dawson, Limited.—For the third year in succession this firm has received the order to light the huge Christmas tree given by the proprietors of the *Pall Mall Gazette* to the East End poor at the Great Assembly Hall, Mile End Road. This year they are putting in nearly 200 lights on the tree, and each light being enclosed in a silk bag, the effect is very charming.

State of Trade during 1894:—

Manchester Edison-Swan Company, Limited.—This company report an exceptionally busy year. The principal installation they have carried out is the central station of the Altrincham Electric Supply, Limited (for which they obtained the complete contract), an alternate current station working at 2,000 volts and supplying electricity over a large district of Altrincham and Bowdon. The alternators used are of the Manchester Edison-Swan Company's make. They have also constructed central station apparatus for several corporations and supply companies, including the large switchboard for the Bolton corporation. A number of private installations for private houses, shops, hotels, warehouses, &c., have also been carried out by them in provincial towns.

Delaware Hard Fibre Company.—Mr. Burns reports that the past year has been one of continual progress, and that the company have had to acquire extended warehouse room for the larger stock needed to execute orders promptly. Their stock of

sheets, rods, and tubes is now very complete, and special attention is given to the supply of washers and special shapes.

The Bedford Electrical Engineer.—Mr. William J. Hope Johnstone has been appointed engineer at the Corporation electrical works.

The Electrical Company, Limited.—This company has lately added a new department to their business which is to be devoted to electric bells. They have sent us a copy of their illustrated price list of the apparatus they intend supplying. The list is neatly produced and describes a variety of bells and accessories.

The Electric Construction Company, Limited.—Sir Daniel Cooper, Bart., G.C.M.G., Chairman of the Electric Construction Company, Limited, entertained the staff and employés of that company at dinner in the Victoria Hotel, Wolverhampton, on Saturday, 5th inst. Upwards of 120 gentlemen were present. The chair was occupied by Mr. James W. Barclay, in the unavoidable absence of Sir Daniel Cooper. During the evening an address was presented to Mr. E. Garcke, on the occasion of the expiry of his agreement as managing director of the company.

The Waltham Electrical Engineering Company, Limited, are sending out a folding card with the season's compliments, upon which they illustrate three of the old gateways of England, *i.e.*, Easby, Ely, and Bolton.

Vandam & Co.—Mr. A. Vandam, formerly of 102, Ridgmount Gardens, took Mr. T. Herbert Marsh into partnership on December 1st. The address of the firm, now known as Vandam and Co., is Albany Buildings, 39, Victoria Street, Westminster.

Mr. T. E. Marsh wishes us to state that he is not the Mr. Marsh referred to above.

Venezuela Telephone and Electrical Appliances Company, Limited.—The *South American Journal* says "We are able to submit the following statement, showing the results of the working of this company for the past five months of the financial year 1894-95, as compared with the corresponding period of 1893-94. It will be seen that these have been most satisfactory from every point of view. The number of telephones connected in July, 1893, was 1,978 against 2,319 in July, 1894, increased to 2,241 in September, and to 2,262 in October last. The following particulars are interesting:—

	July.	Aug.	Sept.	Oct.	Nov.
Gross earnings:—					
1893-94	£1,600	£1,680	£1,650	£1,650	£1,740
1894-95	1,835	1,843	1,840	1,880	1,877
Working expenses:—					
1893-94	£1,072	£1,005	£960	£950	£980
1894-95	960	1,003	1,000	1,000	957
Net earnings:—					
1893-94	£528	£675	£690	£700	£760
1894-95	875	840	840	880	920
Net increase:—					
1894-95	£347	£165	£150	£180	£160"

Yarmouth Town Hall Lighting.—Messrs. Laurence and Scott are to light the Town Hall at a cost of £418.

CONTRACTS OPEN.

London, N.W.—January 24th. Tenders are invited for the supply and running of mains, and the wiring of the buildings and grounds of the North-Western Fever Hospital, Haverstock Hill, for the Metropolitan Asylums Board. Particulars obtainable at the offices of the Board, Norfolk House, Norfolk Street, Strand, W.C.

Nelson.—January 18th. Tenders are invited for lighting Stanley Street Chapel, Nelson, with electricity. Particulars to be obtained from, and tenders sent to, Mr. James Bateson, 10, Primrose Street, Nelson.

Spain.—Tenders are at present being invited by the Spanish General Direction of the Posts and Telegraphs in Madrid for the establishment and working, under a 20 years' concession, of a telephone exchange at Logrono, a busy agricultural centre in the province of Burgos.

Spain.—The municipal authorities of Albacete, a busy town in New Castile, and called the Sheffield of Spain, are at present inviting tenders for the establishment and operation of a central electric lighting station in the town under a 30 years' concession.

CITY NOTES.

Collier Audible Telephone Syndicate.

THE summary and observations have been issued by Mr. Wheeler (liquidator) under the winding-up order made against this company. The syndicate was formed to acquire and develop patent rights granted to Mr. A. T. Collier for an improved audible telephone, to take out foreign patents, to acquire the machinery and plant at the works, Gray's Inn Road, and to generally carry on a telephone and electrical manufacturing and supply company. The promoters of the syndicate were the London and Colonial Finance Corporation, Limited, of which Mr. Harry Seymour Foster, M.P., was a director. That gentleman was also a signatory to the memorandum. The purchase price was to be £6,000, in 60 fully paid shares of £100 each, and a sum of £350 was also to be paid for tools, &c. The corporation was to provide the necessary officers, and to pay all expenses down to the first allotment. The capital was £9,000, in 90 shares of £100 each, and all the shares were allotted. No fees were fixed or paid to the directors. The capital having gone in experiments, £4,000 of debentures were issued, £1,000 was taken by the corporation at 90 per cent., and a loan of £1,000 was raised from the corporation upon the security of £1,500 debentures, and the syndicate's acceptance for the £1,000 at three months on was eventually paid off. In August, 1892, the Collier-Marr Telephone and Electrical Manufacturing Company, Limited, was formed to take over the whole of the assets of the syndicate for £50,000, of which £4,000 was payable in cash. The promoters of the new company were Mr. J. J. Graham and the corporation, and they agreed jointly to effect the underwriting of £40,000 of shares in the company, and to bear all the costs and expenses of the promotion in consideration of £10,000 in cash and £5,000 in shares. Owing to difficulties, the underwriting was reduced to £10,000, and the purchase consideration was also altered, the new company paying the syndicate £4,000 in cash and £46,000 in cash or shares, and the syndicate paying the promoter £3,000 in cash and £12,000 in cash or shares. In order to carry the sale out, the syndicate went into voluntary liquidation. The business has been carried on in London and Manchester. The debts are returned at £606 9s. 5d., and the assets at £26,223 18s. 11d. Mr. Wheeler observes that the statement of affairs does not correctly represent the position of the syndicate, inasmuch as the asset £26,000 represents the face value of shares in the Collier-Marr Company, Limited. They are deferred shares, and are not expected to realise anything approaching this sum. An extract from the minutes of a meeting of the creditors is to the effect that in May, 1894, Mr. J. J. Graham, of Manchester, director of the Collier-Marr Telephone and Electrical Manufacturing Company, Limited, offered, in the event of the shareholders not raising the money required to pay off the creditors, to purchase the 2,600 shares in the hands of the liquidator for £500. This was not accepted, and Mr. Graham is not now prepared to make an offer for the shares. There are matters in connection with the conduct of the business of the syndicate and of the voluntary liquidation which require further investigation.

The Electrophone Company, Limited.

THE prospectus is issued of this company with a capital of £20,000 in £5 shares. The company is formed to take over and develop the business of the Electrophone Syndicate. The primary outlay by the company, the prospectus states, will be for the provision of not less than 100 automatic boxes, for securing, furnishing, and fitting up premises for the electrophone at places of public resort, and for opening depôts where the public can have hearings through the company's system. The purchase price of the property, &c., enumerated in the prospectus for the whole of the United Kingdom, has been fixed by the contract between the vendors and the company at £15,000, payable as to £7,750 in fully paid shares of the company, as to £2,250 in cash, and the balance in cash or shares at the option of the directors.

Eastern Extension, Australian and China Telegraph Company, Limited.—The interest on the 4 per cent. mortgage debenture stock for the half-year ending January 31st, will be paid by warrant on February 1st. The stock register will be closed from 28th to 31st inst., both days inclusive.

Stock Exchange Notices.—Application has been made to the Stock Exchange Committee to appoint a special settling day in, and to grant a quotation to—City of London Electric Lighting Company, Limited, provisional scrip certificates of a further issue of £200,000 5 per cent. debenture stock.

The Salisbury Electric Light Company, Limited.—This company has been formed for the purpose of supplying electricity in Salisbury, with a capital of 20,000 shares of £1 each, and a debenture capital of £10,000.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending January 6th, 1895, amounted to £1,004; week ending January 7th, 1894, £990; increase, £14; total receipts for half-year, 1895, £1,004; corresponding period, 1894, £990; increase, £14.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of December, 1894, amounted to £1,671, against £1,895 in the corresponding period of last year.

The Great Northern Telegraph Company. The traffic receipts in December, 1894, were £24,800; January 1st to December 31st, 1894, £285,800; corresponding months, 1893, £269,200; corresponding months, 1892, £266,400.

The Liverpool Overhead Railway Company. The traffic receipts for the week ending January 6th, 1895, amounted to £926; corresponding week last year, £688.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 4th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £9,253.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, January 2nd.	Closing Quotation January 9th.	Business done during week ended January 9th, 1895. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	100 —103xd	101 —104 xd	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 12s.	£2 15s.	£2 11s.	38 — 39	39½— 40½	38½	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 5s.	£5 10s.	£5 2s.	71½— 72½	73½— 74½	74⅛	72
2,993,560£	Do. do. Defd.	Stock	...	...	...	6½— 6⅝	6½— 7	6¼	...
130,000	Brazilian Submarine Teleg., Ltd.	10	8 % §	6½% §	6½% §	10¼— 10¾	10⅜— 11¼xd	11	10½
75,000£	Do. do. 5 %, repayable June 1906	100	...	...	...	109 —113xd	109 —113 xd	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	... §	10%‖ §	... §	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	140 —150xd	140 —150 xd	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	3½% §	2 % §	2 % §	1/16— 1/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½— 13½	12½— 13½	13½	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4½%	4 %	4 %	4¼— 4⅜	4 — 4½	...	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	10 %	9¼— 9⅜	9½— 10	...	...
30,000£	Do. do. 4½ % Debs of £50, Nos. 1 to 1,600	...	...	...	...	105 —108%	103 —106%xd	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½% §	3½% §	2⅝% §	8¼— 8⅞	8¼— 9	8¾	8⅜
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6¼% §	6¼% §	6½% §	16 — 16¼	16⅛— 16⅜	17 15/16	16⅛
70,000	Do. 6 % Pref.	10	6 % §	6 % §	6 % §	16⅜— 17¼	17 — 17½	17⅜	17⅛
102,100£	Do. 5 % Debs., repay. August, 1899	100	...	...	...	106 —110	106 —110	..	...
1,297,837£	Do. 4 % Mort. Deb.	Stock	...	...	...	120 —123	121 —124	122½	121⅜
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	16⅛— 16⅜	16¼— 16½	16½	16 3/16
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	...	...	...	101 —105xd	102 —106 xd	103½	102½
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	102 —105xd	103 —106 xd	104⅜	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	119 —123	121 —124	...	...
95,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	...	...	...	101 —105xd	102 —106 xd	...	...
129,100£	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	102 —105xd	103 —106 xd	104	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	105 —108	106 —109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	109 —112%	111 —114%	111⅜	...
180,227	Globe Telegraph and Trust, Ltd.	10	5⅛% §	4⅞% §	4⅝% §	8⅜— 9	8⅞— 9⅛	9⅛	8⅞
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 % §	16 — 16¼	16¼— 16⅜	16⅜	16⅛
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜% §	8⅜% §	8⅜% §	21½— 22xd	21¾— 22¼xd	21¾	...
190,000£	Do. do. do. 5 % Debs.	100	...	...	...	105 —108	105 —108	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	47 — 49	48 — 50	48¾	48½
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	5 — 7	5 — 7	...	...
100,000£	Do. do. 6 % Debs.	100	...	...	...	102 —106	102 —106	...	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	¼— ⅜	¼— ⅜	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1⅛— 2⅛	1½— 2⅜	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	6 % §	5 % §	5 % §	5⅛— 5⅝	5⅛— 5⅜	5 7/16	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	15 — 16	15 — 16	15⅜	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	5¾— 6	5⅞— 6⅛	6 1/16	6
1,100,000£	Do. 3½ % Deb. Stock Red.	...	...	...	...	... ...	103 —105	103¾	103½
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... ...	... ...	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	...	1/32— 3/32	1/32— 3/32	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	103 —106xd	104 —107 xd	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	0 %	2 — 4	2 — 4	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	110 —115	110 —115	...	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	1 — 2	1 — 2	...	...
146,733£	Do. do. 5 % Debs.	Stock	...	...	...	86 — 91xd	86 — 91 xd	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	..	0 %	3 — 5	3 — 5	...	...
238,300£	Do. do. do. 5 % Debs.	100	...	...	...	101 —104	101 —104	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1½— 2⅛	1½— 2⅛	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	96 —101xd	96 —101 xd	...	...
64,245	Western and Brazilian Teleg., Ltd.	15	4 %	2½%	2½%	11¼— 11⅜	11 — 11⅛	11⅛	11⅜
33,129	Do. do. do. 5 % Cum. Pref. ...	7½	...	...	...	6¼— 6⅜	6¼— 6⅜	...	...
33,129	Do. do. do. 5 % Def.	7½	3 %	...	...	4⅜— 5¼	4⅜— 5¼	5⅛	4 15/16
171,900£	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	101 —105	101 —105	...	...
214,800£	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	101 —105	101 —105	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	¼%	⅜%	1 — 1¼	1 — 1¼	1¼	...
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	10⅜— 11¼	10⅜— 11¼	11⅛	10⅜
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	...	..	9 — 10	9 — 10	...	...
80,000£	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	107 —110xd	107 —110 xd	...	...
$1,211,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	112 —118	115 —120	118	...
166,900£	Do. do. 6 % Ster. Bonds.	100	...	...	...	102 —104	102 —104	102½	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	...	5 %	4½%	4⅛— 5⅛	4⅛— 5⅛	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	...	14 — 15	14 — 15	...	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	...	6 %	6 %	15 — 15½	15 — 15½	15½	15¼
100,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	130 —133xd	130 —133 xd	131½	130
50,000	†Liverpool Electric Supply, all paid	5	4½%	5 %	5 %	7 5/16— 7 7/16	7 5/16— 7 7/16	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	1 %	2 %	2½%	10 — 10½	9¾— 10¼	10 3/16	10
100,000£	Do. 5% Deb., bonds of £10, £20, £40	...	...	...	...	... ...	... ...	...	...
150,000£	Do. 4½% first mortgage debenture stock	...	...	...	...	115 —118 xd	116 —119 xd	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	7½— 7⅝	7½— 7⅝	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	8½%	7¼%	4½%	7⅝— 8¼	7⅝— 8¼	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8¼— 9	8⅜— 9¼	...	...
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	...	3½%	4 %	7½— 7⅝	7½— 7⅝	7⅝	7½

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, Jan. 2nd.	Closing Quotation, Jan. 9th.	Business done during week ended Jan. 9th, 1895. Highest.	Lowest
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	3	...	6 %§	6 %§	2½— 2⅝	2⅝— 2⅞	2¾	2 11/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	...	6 %§	6 %§	2⅝— 2⅞	2½— 2⅝	2⅝	2⅝
125,000£	Do. do. 4½ % Deb.	Stock	...	...	...	111 —114	111 —114	...	...
630,000£	City and South London Railway	Stock	...	⅝%	⅝%	43 — 45	43 — 45	45	44
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 %§	7 %§	7 %§	3 — 3½	3 — 3½	...	...
50,000£	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	97 —102	97 —102	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	¼— ½	¼— ½	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1½— 2	1½— 2	...	...
100,000	Elmore's French Patent Cop. Deposg., Ltd., 1 to 66,750 ...	2	*nil*	*nil*	*nil*	1/16— 3/16	1/16— 3/16	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil* ¶	*nil*	*nil*	1¼— 1⅜	1¼— 1½	1⅜	1 5/16
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	*nil*	1½— 1⅝	1½— 1⅝	1¼	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	*nil* §	½— 1½	½— 1½	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	...	...	6½— 7	6½— 7½	...	...
6,837	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	5 %	8½— 9¼	8½— 9½	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	12½%	25½— 26½	25½— 26½	26⅜	26
200,000£	Do. do. do. 4½ % Deb., 1896	100	...	...	...	102 —104	102 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	...	1 %	8⅝— 8¾	8⅝— 9	...	...
6,295	† Do. do. Pref., £8 paid	10	...	...	...	13 — 13½	13 — 13½	...	...
	Swan United Electric Light, Ltd.	...	11 %§	10 %§	7½%§	... — ...	... — ...	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	20 %	41 — 43	41 — 43	42½	41¼
150,000£	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	104 —107 xd	104 —107 xd	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ...	10	...	...	...	2¼— 2⅜xd	2¼— 2⅜xd	2⅜	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¼—5⅜.
Electric Construction Corporation, 6 % Debentures, 93—97.
Electric and General Investment, shares of £5 (£1 paid), 1¾—2¼.
House-to-House Company (£5 paid), 2⅛—2¼.
Do. do. 7 % Preference, of £5, 6½—7.
Do. do. 6 % Debentures of £100, 105—107.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 7—7¼; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7⅛.
Liverpool Electric Supply, £5 (fully paid), 6⅞—7.
London Electric Supply Corporation, £5 Ordinary, ¼—½.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 99—101.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4⅛—4⅜.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

ON THE PROPERTIES OF BATTERIES FORMED OF CELLS JOINED UP IN MULTIPLE ARC.*

By B. O. PEIRCE.

If three galvanic cells, the electromotive forces of which are e_1, e_2, and e_3 respectively, and the internal resistances, b_1, b_2, and b_3, be joined up parallel to each other, the battery thus formed is equivalent—so far as its ability to send electricity through an external circuit is concerned—to a single cell of electromotive force, e_0, and of internal resistance, b_0, where

$$e_0 = \frac{e_1\, b_2\, b_3 + e_2\, b_1\, b_3 + e_3\, b_1\, b_2}{b_2\, b_3 + b_3\, b_1 + b_1\, b_2},$$

$$b_0 = \frac{b_1\, b_2\, b_3}{b_2\, b_3 + b_1\, b_3 + b_1\, b_2}$$

A similar statement† may be made about a battery of any number of cells connected in multiple arc. It is evident, however, that the efficiency‡ of such a battery of unlike cells is less than that of a single cell which would do the same amount of useful work under the same external circumstances.

I have had occasion of late to consider some relations between the strengths of the currents which pass through the different members of a given battery of unlike cells joined up in multiple arc. Many persons must have used the equations which I found convenient in this work, but I cannot find that any one§ has taken the trouble to print them all. I therefore give a few of them here, with some well known formulæ introduced for the sake of clearness.

Let the internal resistances of n cells, which are joined up in multiple arc with each other and with a conductor of resistance, r, be b_1, b_2, b_3, . . . respectively, and the electromotive forces be e_1, e_2, e_3, . . . Let C be the current which flows through the outside resistance, r, and let C_k be the current which flows, in the same cyclic direction as C, through the kth cell. Then, if $b_k = \lambda_k\, r$,

$$C = \sum_{k=1}^{k=n} C_k; \qquad (1)$$

$$b_k\, C_k + r\, C = r\,(\lambda_k\, C_k + \sum_{p=1}^{p=n} C_p) = e_k. \qquad (2)$$

Let the determinant of the coefficients of the C's in the set of n linear equations of which (2) is an example, be denoted by Δ_n; then

$$\Delta_n = r^n \begin{vmatrix} 1+\lambda_1 & 1 & 1 & 1 & \cdots \\ 1 & 1+\lambda_2 & 1 & 1 & \cdots \\ 1 & 1 & 1+\lambda_3 & 1 & \cdots \\ 1 & 1 & 1 & 1+\lambda_4 & \cdots \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots & 1+\lambda_n \end{vmatrix}$$

or $$\Delta_n = r^n\, \delta_n.$$

It is evident that δ_{n+1} would be equal to the product of λ_{n+1} and δ_n plus the product of all the λ's from λ_1 to λ_n.

Let M_n represent the product of all the b's.

Let N_n represent the sum of the n products of the b's taken $n-1$ at a time.

Let $P_{n,k}$ represent the sum of the $n-1$ products formed of all the b's except b_k taken $n-2$ at a time.

Let Q_n represent the sum of the n products formed by multiplying every e by all the b's except its own.

Let $S_{n,k}$ represent the sum of the products obtained by multiplying every electromotive force except that of the kth cell by all the b's except its own and b_k.

* *Proceedings* of the American Academy. Presented May 9th, 1894.
† Stepanoff, *Journal Russ. Phys. Chem. Soc.*, xii. 38.
‡ Slouginoff, *Journal Russ. Phys. Chem. Soc.*, xiv. 2.
§ I have not had access to the papers of Messrs. Stepanoff and Slouginoff quoted above.

Then $$\Delta_n = M_n + r N_n. \quad (3)$$

The determinant formed from the determinant of the coefficients (Δ_n) of the C's in the n linear equations of which (2) is a type, by substituting the corresponding e's for the elements of the kth column shall be called $\Delta_{n,k}$.

$$\Delta_{n,k} = \frac{e_k (M_n + b_k r P_{n,k}) - r b_k S_{n,k}}{b_k}. \quad (4)$$

Hence,

$$C_k = \frac{e_k (M_n + b_k r P_{n,k}) - r b_k S_{n,k})}{b_k (M_n + r N_n)}. \quad (5)$$

The current in the kth cell may be positive, zero, or negative according to circumstances. If the electromotive forces and the internal resistances of all the cells are given, C_k will be positive if r be made less than $\frac{e_k M_k}{S_{n,k} - e_k P_{n,k}}$.

The currents in all the cells will be positive if r be made sufficiently small. If the electromotive forces of the cells are unequal, and if r is very large, the currents in the weakest cell or cells will be negative. If the outside conductor be removed so that the poles of the battery are not connected externally, the current in the kth cell will be positive if e_k is greater than $S_{n,k} \div P_{n,k}$. Thus, if the battery consists of three unlike cells numbered in order of descending electromotive force, C_1 must be positive, and C_3 negative, but C_2 will be positive or not according as e_2 is or is not greater than $\frac{e_1 b_3 + e_3 b_1}{b_1 + b_3}$.

The case of a number of cells of the same internal resistance but of different electromotive forces joined up in multiple arc is of some interest when one has to use a number of unequally charged storage cells to send a very heavy current through an outside circuit of extremely low resistance. When the b's are all equal,

$$C_k = \frac{e_k (b + n r) - r \Sigma (e)}{b (b + n r)} \quad \text{and} \quad C = \frac{\frac{\Sigma e}{n}}{\frac{b}{n} + r};$$

so that the equivalent cell has an electromotive force equal to the average of the electromotive forces of the given cells, and an internal resistance equal to $\frac{1}{n}$th of that of each cell.

This case also throws some light on the properties of a thermal junction of large area formed of two plates of metal soldered together flatwise when, as is sometimes the case in practice, it is impossible to keep the whole junction at exactly the same temperature.

Equations (1) and (5) give the equation

$$C = \frac{\Sigma \left(\frac{e_k}{b_k}\right)}{1 + r \Sigma \left(\frac{1}{b_k}\right)} = \frac{\frac{Q}{N_n}}{\frac{M_n}{N_n} + r} \quad (6)$$

which defines Stepanoff's equivalent cell* already mentioned. The difference of potential between the poles of the battery is

$$V = \frac{r Q}{M_n + r N_n}. \quad (7)$$

When r is made to increase indefinitely, V approaches as a limit the electromotive force Q/N_n of the equivalent cell, and C_k approaches $\frac{e_k P_{n,k} - S_{n,k}}{N_n}$, the current in the kth cell when the poles of the battery are not connected by any external conductor.

If there is a battery of electromotive force E in the external circuit, r, the quantity E must, according to the direction of this external electromotive force, be added to or subtracted from the second member of each of the equations of which (2) is an example. If a battery of n cells joined up in multiple arc be itself connected up parallel with a cell of electromotive force E and of internal resistance, B, $E \div B$ must be added to the numerator of the fraction which forms the second member of (6), and $r \div B$ to the denominator. Upon an examination of these cases, it appears that, if a battery of cells joined up in multiple arc be itself connected up parallel or in series with another battery, or if it be used for compensation purposes, it will exert the same influence upon the currents and differences of potential in parts of the circuit external to itself as its equivalent cell would exert.

The internal work done in the battery when its poles are connected by the external resistance, r, is

$$W_i = \sum_{k=1}^{k=n} (C_k^2 b_k). \quad (8)$$

The internal work done in the equivalent cell would be

$$W_i' = \frac{M_n}{N_n} \left[\sum_{k=1}^{k=n} (C_k)\right]^2. \quad (9)$$

Let w be the difference between W_i and W_i', and in the equation found by subtracting the members of (9) from the corresponding members of (8), let $e_k - C r$ be substituted for its equal $C_k b_k$. It will then be found that all the terms which contain r disappear, since the co-efficients of $C r$ and of $C^2 r^2$ vanish identically, and that

$$w = \frac{M_n}{N_n} \sum_{k=1}^{k=n} \frac{(e_k - e_j)^2}{b_k b_j}; \quad (10)$$

where the sign of summation introduces once only every value of $(e_k - e_j)^2$, in which k is different from j, and neither k nor j is greater than n.

Since w does not involve r, it (w) is the work done inside the battery when its poles are not connected by any external resistance. Equation 10 shows that w cannot be negative, and that it is different from zero unless all the cells in the battery have equal electromotive forces. The expression for w may be written in a form due to Slouginoff,

$$w = \sum_{k=1}^{k=n} \left(\frac{e_k^2}{b_k}\right) - \frac{e_0^2}{b_0}, \quad (11)$$

where e_0 and b_0 are the electromotive force and the internal resistance respectively of the equivalent cell.

It is known that if the poles of a battery formed of n cells be connected by an outside resistance r, the current in the external circuit will be the same, whether the cells be joined up in series or in multiple arc, provided that

$$r = \frac{Q_n \Sigma (b_k) - M_n \Sigma (e_k)}{N_n \Sigma (e_k) - Q_n}; \quad (12)$$

or, if the cells are all alike, provided that $r = b$. It is worthy of notice, however, that the efficiencies of the battery are different in the two cases. If the cells are joined up in series, the efficiency of the battery is

$$F_s = \frac{r}{r + \Sigma (b_k)},$$

but if they are joined up in multiple arc the efficiency is

$$F_p = \frac{C^2 r}{C^2 r + \Sigma (C^2_k b_k)};$$

so that

$$\frac{F_s}{F_p} = \frac{C^2 r + \Sigma (C^2_k b_k)}{C^2 r + C^2 \Sigma (b_k)}. \quad (15)$$

If the cells are all alike, and if $r = b$, this ratio has the value $1 \div n$, and the arrangement in parallel is n times as efficient as the arrangement in series. In the case of unlike cells, if the currents in the cells are all positive, F_s is always less than F_p. It is easy, however, to find cases where F_p is less than F_s, for this is true when

$$\Sigma (C^2_k b_k) < [\Sigma (C_k)]^2 . \Sigma (b_k).$$

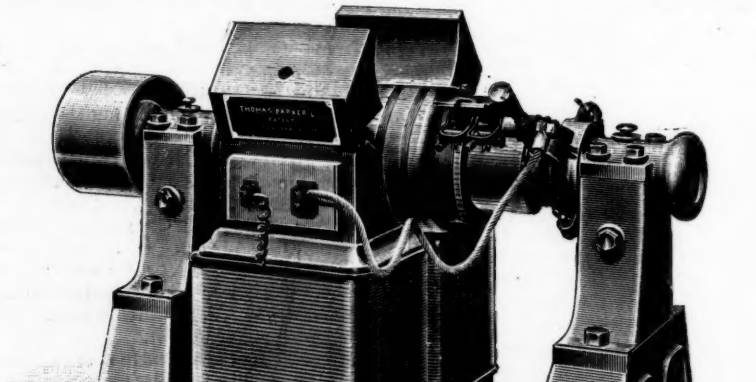
Cambridge, U.S.A., *July*, 1894.

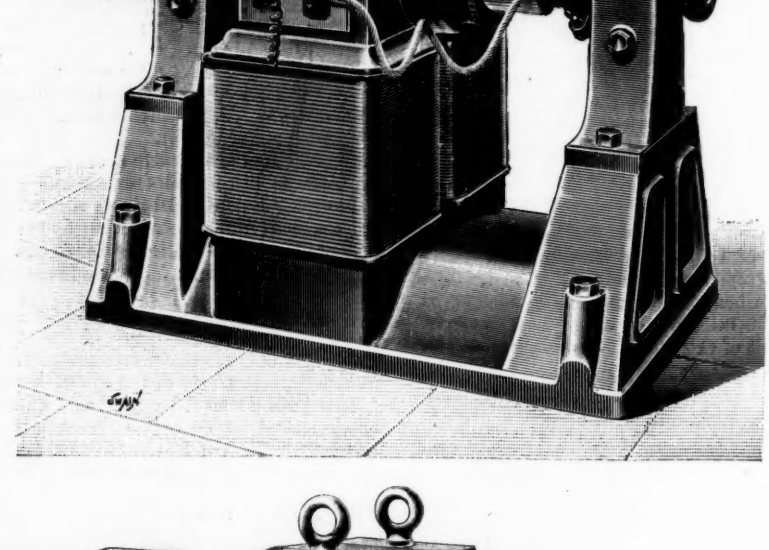
* See also Slouginoff, *Carl's Repertorium*, xvi., 539.

PARKER'S NEW CONTINUOUS CURRENT DYNAMO.

THE main feature of the continuous current dynamo made by Thomas Parker, Limited, is the cutting through of the pole pieces, and hinging these so that they can be turned back to allow of examination, or taking out, of armature by a direct vertical lift, and without unsetting the bearings. The hinge is placed at the angle of the pole piece, so that when turned back half way the magnet ferrule can be lifted

off (after the armature has been removed) without uncoupling the hinged piece. This arrangement allows of machines being fixed in confined spaces, which would not be suitable with the ordinary type of machine, where armature has to be threaded "into" or "out of" the magnets. There is also considerably less risk of damage in withdrawing or replacing the armature. There is an oil well in the pedestal underneath the bottom of the bearing (the bottom bearing being concontinuous); a ring runs in this well and over the top of the shaft, giving continuous lubrication. Where machines are





coupled direct to high speed engines, the armatures are at the bottom, the pole pieces in this case also being cut through, so that the upper portion of the magnets can be lifted away and the armature then lifted out.

With these new arrangements the putting in or taking out of an armature is much more simple, and should occupy far less time than is required by the old method. We are informed by Messrs. Parker that all armatures are coil-wound, under the Eickemeyer patents.

REGULATIONS FOR ELECTRIC CONDUCTORS ON PUBLIC ROADS IN FRANCE.

FROM a copy of the prefectorial resolution controlling the laying down and working of electric conductors on public roads, published in *L' Energie Electrique*, we give a summary of the rules of more or less general interest.

The laying down and working of electric conductors upon public roads are subject to the provisions of the present resolution as far as concerns the security of public traffic, and the preservation of works, without prejudice to the application of the laws and regulations depending on the postal and telegraph service. The laying down and working of the conductors from which the trains of railways, or of tramways, or boats propelled by electricity, collect directly the currents which drive their machines, continue to be subject to the conditions prescribed by the authority entrusted to the said

railways, tramways, or boats, and by the postal and telegraph service.

The first chapter of the resolution relates to administrative rules. Any person wishing to lay down or erect electric conductors on the public roads must apply to the prefect on the form prescribed by the prefectorial resolution of December 1st, 1859. In the case of a municipal installation, the mayor makes the application. Three copies of the application must be filed, and every application must be accompanied by plans, profiles, designs, and the necessary declarations to define the site, the nature and manner of the installation, the electric constants and the insulation of the projected conductors, also the precautions to be taken against heating. The written consent of the adjoining proprietors to whose houses the supports are to be fixed, must be filed. For aerial conductors, it is necessary to specify the type of the supports, their dimensions, the site of each, with satisfactory evidence of their solidity, the solidity of the conductors, the strains exerted upon the points of attachment under the action of the weight of the conductors, of the wind, &c. The type of insulator proposed must be specified.

For subterranean conductors the situation of the projected conduits relative to existing systems of drains, water mains, pipes for compressed air, gas, or electric conductors, must be shown. The projected electric conductors must never come nearer than half a metre to metallic masses or other electric conductors. The type of the cables and the system of the installation must also be shown.

After the first part of the work has been executed, plans must be submitted to the chief departmental engineer who will decide whether the regulations have been properly complied with. Tests of the insulation and of other points required by the regulation must be made in presence of the engineer or his delegate, before the contractor is allowed to put the installation in operation. After the installation is in operation the contractor is required to make tests of the insulation, &c., as often as possible in presence of the departmental engineer and report to the department. If it is required to execute branch work during the working of the main installation, notice must be given at least three days in advance. Any changes in the system of conductors must be notified once every year.

The second chapter of the regulations relates to special technical requirements for aerial conductors. No supports can be fixed on any public property unless they are guaranteed to produce no disturbance of traffic, and to be of sufficient solidity. The conductors should be mounted on insulators of a type approved by the prefect, and capable of sustaining a difference of potential of not less than 200 volts with alternating currents, and 400 volts with continuous current. The distance between two successive insulators should not be more than 100 metres. The conductors should be of sufficient tensile strength and should be inaccessible to the public. When the currents are alternating, or in the case of continuous currents, of more than 400 volts, the contractor must fit special devices to absolutely prevent the passers-by touching the conductors. When the conductors are erected on planted roads the trees must be pruned under the supervision of the department, so that a conductor is at no point nearer to a tree than 1 metre. Every conductor crossing a public road should be at least 8 metres above the ground; the angle which it makes with the direction of the road should be not less than 60° In crossing canals the height of the conductor above the water should be not less than 17 metres. A much greater height may be prescribed for rivers navigable by large ships; no conductors across arms or channels of the sea are allowed.

In the case of conductors running along the public ways, the points of attachment ought to be at least 6·50 m. above the ground, and the conductors themselves ought to be nowhere less than 6 metres above the ground. In crossing inhabited places the electric conductors should comply with the following rules. The conductors of the main system, since they are generally supported by the adjoining houses, ought to be placed at least 1 metre from the front, 0·50 m. at least above the highest windows, and in every case beyond the reach of the inmates. They ought to be 2·50 m. above the highest point of any roof which they cross. The employment of naked conductors will not be sanctioned, if the voltage exceeds 120 volts for alternating currents, or 400 volts for continuous currents. The branch service conductors ought to be covered with insulating material from their junction with the main conductor to the interior of the property which they supply.

The insulating material should not be subject to injurious changes of physical state by heat or inclement weather. The insulating material should be at least 0·0025 m. in thickness, and should be protected on the exterior from deterioration or wear and tear by friction.

The third chapter relates to special technical requirements for subterranean conductors. The conduits should run under the sideways, at a minimum depth of 0·60 m. The electric conductors ought to be placed in the conduits in a resistant and durable material; but armoured cables may be placed directly in the ground. In some cases armoured cables are to be exclusively employed, for example, when the conductors frequently encounter metallic water pipes, gas pipes, compressed air pipes, &c., or when they have to run at less than 0·5 m. from these conduits; when they are placed in metallic conduits, and when the sideway is less than 2 metres wide. Conduits, of whatever kind, should be constructed to prevent the introduction of water, and if by accident water should gain access, provision should be made for its escape. Conductors crossing under roads should be accessible without digging up the road. When electric conductors run near gas conduits and the conductors are not laid directly in the ground, the necessary measures should be taken to insure the regular ventilation of the conduit containing the electric cables, and to prevent the accumulation of gas. Electric conductors forming service branches should be covered with an insulating material mechanically protected either by the armour of the cable or by conduits of sufficiently resistant material.

In the fourth chapter are given some general provisions. It is forbidden to employ the earth for the return current. No transformer should be placed on the public road unless by special authorisation. The contractor is to be responsible for accidents notwithstanding any authorisations granted. Rents are to be charged for the use of public property.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY.

A DEPUTATION of gentleman interested in the cricket tour to the West Indies, in the West Indian colonies, and in English cricket tours generally, recently had an interview with the directors of the West India and Panama Telegraph Company, Limited, with reference to the very great desirability, in the interests of all concerned in the West Indies, of bringing them into more ready intercourse with this country.

The deputation consisted of General Graham and Mr. Samson (editor of the *South American Journal*), members of Council of the British and West Indian Alliance, on behalf of West Indian interests generally, Mr. Lucas, who, with Lord Hawke, is organising the team of English amateurs in response to the invitation of the West Indian clubs and colonies, and Dr. Anderson, representing the West Indian cricket clubs.

It was pointed out that it is most desirable that every report of the tour of the cricket team, which English newspapers will publish, should be readily at the command of the latter, and the deputation would wish to represent that the ordinary rates charged for transmission are so high as to prevent newspapers from accepting any telegraphic accounts, as expressly stated by Messrs. Reuter in reply to a letter of inquiry from Dr. Anderson.

Having regard to the fact that Press telegrams from America are 5d. per word, the deputation urged upon the company, if possible, to grant a Press rate of 1s. per word. The West Indian colonists will, the deputation stated, regard such a concession at this juncture as a most valuable service.

The CHAIRMAN, in reply, observed that the matter was by no means so simple as it might appear. The company's system extended throughout the West Indies, but messages to Europe had to be transmitted over five other systems, two in Cuba, one in Florida, one in New York, and thence to this country, and over the rates charged by these lines the company had no control. The occasion, however, was one of exceptional interest, and the company had every desire to meet the views of the deputation. They proposed, in order to do this, to convey, for this occasion, messages of not more than 50 words per match free over their own lines, and to endeavour to induce the companies owning the transmitting lines to accept half rates; this would give an average rate for this purpose of about 2s. 3d. per word, and the deputation would, he was sure, feel that, having to arrange terms with, and pay rates to other companies, this would be as much as they could well attempt.

Lord STAMFORD expressed the satisfaction felt by the deputation at their reception by the company and at the proposals made, and thanked the company on their behalf.

NEW PATENTS—1894.

25,031. "Improvements in electricity meters." G. Hookham. Dated December 24th.

25,066. "Improvements in electro-magnetic devices for varying the self-induction of any electric apparatus, also applicable to dynamos and motors." L. B. Atkinson. Dated December 24th.

25,074. "Process and apparatus for the production of zinc and lead by electrolysis of the melted chlorides." R. O. Lorenz. Dated December 24th.

25,076. "Improvements in or relating to telegraphic transmitters and recording apparatus therefor." A. J. Boult. (Communicated by C. Spiro, United States.) Dated December 24th. (*Complete.*)

25,079. "Improvements in or relating to telegraphic transmitters and recording apparatus therefor." A. J. Boult. (Communicated by C. Spiro, United States.) Dated December 24th.

25,080. "Improvements in or relating to the separation of metals by electric action." T. T. Oliver. Dated December 24th. (*Complete.*)

25,132. "A method of and means for economically producing electricity." J. C. Dagoneau. Dated December 27th.

25,145. "Improvements in the production of copper by electrolysis, and in apparatus employed therein." J. C. Mewburn. (Communicated by La Société L'Electrolyse, France.) Dated December 27th.

25,197. "Improvements relating to the charging materials for primary and secondary galvanic elements." G. Platner. Dated December 28th.

25,221. "Improvements in dynamo-electric generators and motors." L. B. Atkinson. Dated December 28th.

25,231. "Incandescent electric lamp gauge." R. D. Radcliffe and C. L. Philips. Dated December 28th.

25,263. "An improved arrangement of electric call bell or alarum." R. Rogg. Dated December 29th.

25,264. "Improvements in electric or galvanic batteries." J. B. Torres. Dated December 29th.

25,285. "Improvements in the production of electrical illuminative effects especially applicable for exhibition upon the human body and also for illuminative stage and scenic effects in theatres and the like." G. F. Kenyon and W. Reynolds. Dated December 29th.

25,289. "An improved primary battery." V. Ludvigsen. Dated December 29th. (*Complete.*)

25,312. "An improvement in the construction of electric arc lamps." H. Hewitt and A. Casey. Dated December 31st.

25,340. "An improved system of conductors for electrical-decomposing tanks." J. Leith and The Electro-Chemical Company, Limited. Dated December 31st.

25,344. "Improvements in safety devices for electrical circuits." W. C. Johnson and L. J. Steele. Dated December 31st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1893.

21,420. "Improvements in primary batteries." W. H. Longsdorf. (Communicated by G. Hewett, of New York.) Dated November 10th. The objects sought to be attained are to produce a battery giving a large current for a long period of time; cheap and simple to construct, and in which the elements are so arranged and constructed as to maintain a well defined "gravity line." 5 claims.

21,434. "Improvements in electrically heated ovens." F. W. Schindler. Dated November 10th. Consists in providing the oven with two, three, or four independent heating bodies, which may be made to slide into suitable guides formed on the walls of the oven, at the bottom, at the top, or at the sides. 5 claims.

21,958. "Improvements in electric lighting apparatus for use on bicycles and similar vehicles." H. H. Lake. (Communicated from abroad by G. Mayer, of Brooklyn.) Dated November 16th. Has for its object to provide an electric lamp for bicycles and similar vehicles, in which the current electricity shall be generated by means of a dynamo-electric machine, the disposition of which, with reference to the bicycle, shall be such as to render practicable the communication thereto of motion from one wheel of the bicycle, in the event of the latter being turned or rotated upon its axis; which shall admit of ready application to, and removal from, the bicycle, and which shall be simple and cheap in construction, and efficient in operation. 6 claims.

22,674. "Improvements in or relating to electric regenerative batteries or accumulators, and in porous cells therefor." R. Haddan. (A communication from abroad by H. Riguelle, of Belgium.) Dated November 25th. Consists of an outer vessel of a metal unattacked by the liquid used, such as brass covered with lead, this vessel serving both as container and as negative pole. Into this vessel is placed either a mixture of oxide of tin and oxide of lead, or an alloy of tin and lead of the formula Pb_3Sn, both being reduced to powder. The inner porous cell is placed in this mixture, and is preferably made as hereinafter described; it contains a suitable positive pole, preferably of carbon or metallised carbon, surrounded with peroxide of lead in the form of a powder lightly packed into the cell. To form the porous cell asbestos cloth is taken, soaked in boiling water to render it soft and porous, then spread with a composition of kaolin or other porcelain producing compound, pressed between rollers or otherwise, to well impregnate the composition with the cloth, cut into suitably shaped pieces and baked in a similar manner to porcelain, after having been folded on a suitably shaped mould. 3 claims.

23,231. "Improvements in micro-telephones." G. L. Anders and W. Kottgen. Dated December 4th. Consists in making the parts, such as diaphragm, diaphragm ring, bell contact, automatic switch, with the respective insulating rings, all of which being of a circular concentric shape, capable of being placed the one above the other, so that they may be all of them simultaneously clamped into position by the face plate which carries the receiver. 3 claims.

23,472. "Improvements in electrical measuring instruments." F. H. Nalder, H. Nalder, C. W. S. Crawley, and A. Soames. Dated December 6th. The inventors attach a pointer to the moving part in the usual way, and also have an independent pointer or index, actuated by the first one in such a way that it will remain in whatever position it is pushed to by the first pointer. 2 claims.

24,471. "Improvements in electric supply meters." W. Thomson, Baron Kelvin of Largs. Dated December 20th. Relates to an improvement upon Patent No. 18,436, A.D. 1891. The present invention includes, for the clockwork by which the application of the idle roller and the up and down motion of the lifting pin are produced, a new form of automatic starting and winding gear by which as long as the electric pressure of the supply is maintained, the clockwork is kept going, and by which, at any time after the pressure has been taken off and the clockwork allowed to stop, it is rewound and restarted. 2 claims.

1894.

433. "An improved electric switch." C. P. Elieson. Dated January 8th. The inventor provides a tube or container of suitable non-conducting material closed at the ends, the lower end working on metal pivots in suitable bearings, each metallically connected to a terminal or binding screw, such connection extending to the interior of the tube. In order to complete the circuit, he introduces into the tube a quantity of mercury, so that when the tube is in a vertical position the mercury will drop to the bottom of the tube, and the circuit will be completed; and when it is required to break the circuit it is only necessary to reverse the position of the tube, when the mercury will fall to the other end thereof. 5 claims.

5,572. "Elastic ear cushion for use on telephone receivers." F. Fearnley. Dated March 17th. Relates to an elastic cushion in the form of a ring, inflated with air, so placed that the receiver of the telephone does not press on the ear, thereby improving the hearing, and also preventing internal or external damage to the ear. 1 claim.

8,061. "Improved apparatus and process for electro-chemical decompositions." H. Carmichael. Dated April 24th. The more particular aim of the invention is the provision of economical means for electrolysing aqueous solutions of various chlorides, notably the solution of common salt. 30 claims.

8,086. "An electric alarm for pressure gauges." W. H. Bradt. (Under International Convention.) Dated November 22nd, 1893. When the gauge pressure has caused an index-operating mechanism to move the index into engagement with a contact hand, the circuit will be closed by the contact of the electrodes, and the alarm signal will be rung. 3 claims.

8,218. "Improvements in or connected with electric signalling or communicating apparatus." C. S. Jones and H. C. Collier. Dated April 25th. The inventors provide a pendulous circuit-closing device through which a current is designed to flow, and the swinging arm of which when oscillating is adapted to make contact with a fixed contact piece, and to close the circuit at each oscillation. 6 claims.

8,585. "Improvements in electric conductors for underground conduits." D. E. Conner. Dated May 1st. Relates to an electric sub-cable or conductor arranged in an underground conduit for the transmission of electric power for propelling cars, &c., the conduit being of that class having a slot through which projects the stem or blade of a trolley, which is carried by the moving car, and by means of which a current is carried from the specially-constructed and arranged conductor, and contact chain or connected contact pieces, upward to the motor on a car. 12 claims.

10,386. "Improvements in or applicable to clocks for operating electrical alarms." F. Fritz. Dated May 29th. On the arbor of the hour hand is fixed a revolving contact arm which is carried round an indicator plate at the back of the clock. In the indicator plate are seated terminals of wires connected from a separate keyboard, by means of which any desired alarm may be rung at any desired hour. 2 claims.

10,658. "Improvements in, and in connection with, electric bells." F. W. Golby. (Communicated by A. Neumann, of Heilbronn.) Dated June 1st. Relates to improvements in electric chimes, and has for its object to provide a signal or bell telegraph capable of producing more than one tune. 1 claim.

10,659. "Improved apparatus for the suspension of incandescent electric lamps." F. W. Golby. (Communicated by A. Neumann, of Heilbronn.) Dated June 1st. Is to allow of a horizontal as well as of a vertical adjustment of the position of the lamp. 1 claim.

10,851. "Improvements in electric railway signals." H. H. Lake. (Communicated from abroad by F. Beattie, of America.) Dated June 4th. Relates to electric railway signals designed to depend from the cab of a locomotive engine, and to be set in operation by means of a tripping device permanently attached to a railway track adjacent to the rails thereof, and containing a tripping head, and normally retired, but lifted into position for operation when it is designed to set off the signal in the cab, and so warn the engineer. 3 claims.